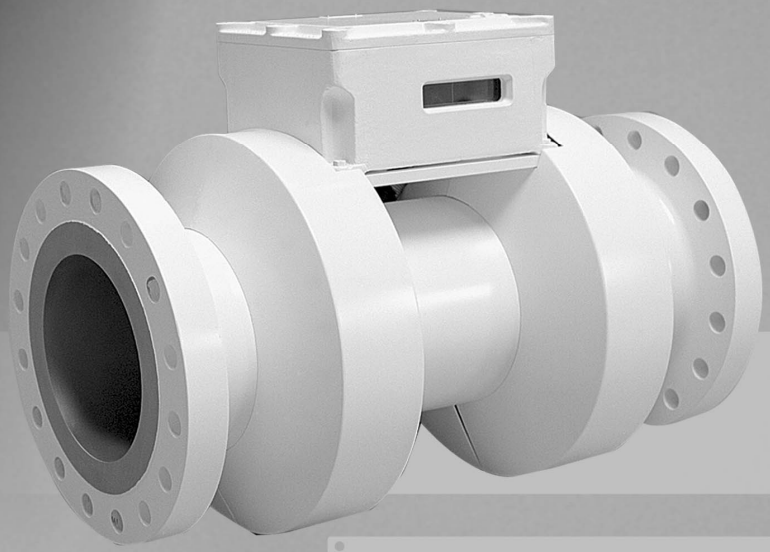
FH8500

User's Manual



FAURE HERMAN

Mastering the Flow

IDEX

LIQUID CONTROLS GROUP

Faure Herman

Route de Bonnétable
BP 20154
72406 La Ferté Bernard Cedex
FRANCE

Tél : +33 (0)2 43 60 28 60
Fax : +33 (0)2 43 60 28 70

E-mail : fhprojects@idexcorp.com

Faure Herman Meter

Houston TX. 77086 (U.S.A.)

Phone : + 1 713 623 0808
Fax : + 1 713 623 2332

E-mail : FHH-Sales@idexcorp.com

Attention!

This manual contains important instructions and important warnings. It is essential to read and apply it before commencing installation, connection, and commissioning work.

Failure to observe these instructions and warnings may damage the flowmeter and endanger persons.

Qualification and training of the personnel

The flowmeter must be installed and maintained by personnel trained and qualified for this work.

Hazards arising from failure to observe the instructions and warnings

Failure to observe these instructions and warnings may:

- Endanger personnel as a result of mechanical, electrical, or chemical problems,
- Damage the flowmeter,
- Pollute the environment by releasing hazardous substances.

Safety at work

The safety instructions appearing in this manual must be observed, as must all accident prevention and occupational safety regulations in force in the country of installation.

Safety instructions

Disconnect the power supply and depressurize the flowmeter before servicing (prevention of electrical hazards and hazards created by pressurized equipment).

Conditions of operation

The reliability of the flowmeter is guaranteed only if it is installed and used as described in this manual. The extreme conditions of use indicated on the data plate must not be exceeded.

Reconditioning, repair, modifications

Reconditioning, repair, or modification are allowed only after Faure Herman has been consulted. The use of parts and accessories approved by Faure Herman avoids compromising safety. If any other parts are used, Faure Herman cannot be held liable for the consequences.

Transport, handling, and storage

The flowmeter must be handled with care so as to avoid damage.

Transport and handling must be performed using resources appropriate to the weight and bulk of the flowmeter.

When the flowmeter has lifting rings, they must be used. The flowmeter must in no case be handled or secured by the electrical boxes.

The use of end caps serves to protect the flanges during transport and handling.

Unpacking

The flowmeter must be checked and inspected in order to make sure that it has not been damaged and that nothing is missing. Protections and devices (such as screws) placed to immobilize moving parts must be withdrawn before installation.

Storage

If the flowmeter is not installed as soon as it is received, it must be suitably stored in a dry place, protected from the elements and from large temperature swings. For prolonged storage, arrangements to protect from damp may be necessary.

Return

Before any return, contact Faure Herman. If the flowmeter has been used with hazardous, corrosive, or toxic substances, the operator must make sure that it has been correctly rinsed, cleaned, and decontaminated before being returned to Faure Herman.

FAURE HERMAN

Mastering the Flow

www.faureherman.com

General contents

Note: The detailed contents are inserted on the end of manual

General contents 5

ATEX recommendations 7

Chapter 1: General overview 15

Chapter 2: Commissioning procedure 25

Chapter 3: Using the FH8500 remote control device 35

Chapter 4: Spare parts and Maintenance 47

Chapter 5: Modbus transmission tables 57

Appendix I 87

Appendix II 89

Appendix III 91

Appendix IV 93

Appendix V 97

Appendix VI 101

Detailed contents 107

Personal notes 113

ATEX recommendations

FR

Recommandations ATEX

Cet équipement est certifié ATEX et conforme aux exigences essentielles en ce qui concerne la sécurité et la santé pour la conception et la construction d'appareils destinés à être utilisés en atmosphères explosibles (Directive 94/9/CE).

Pour une utilisation en toute sécurité, assurez-vous que l'équipement est utilisé conformément aux indications définies dans le certificat ATEX et la plaque d'identification, et respectez les manuels d'utilisation, d'installation et de maintenance de l'équipement et des sous ensembles qui le composent.

L'installation, l'utilisation et la maintenance doivent être réalisées par un personnel formé et spécialisé comprenant l'une des langues du manuel.

S'il vous manque un manuel ou pour toute information, contactez le service Après-vente de FAURE HERMAN :

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
✍ fhservices@idexcorp.com

EN

ATEX recommendations

This equipment is ATEX certified and complies with the essential Health and Safety requirements relating to the design and construction of equipment intended for use in potentially explosive atmospheres (94/9/EC Directive).

On safety grounds, please ensure that this equipment is used in total compliance with the instructions given on the ATEX certificate and nameplate. Please consult the user manuals, equipment installation and maintenance manuals and the various parts used in this device.

This item of equipment must be installed and serviced by trained, specialist staff who understand one of the languages used in the manual.

If you require a manual or any additional information, please contact the FAURE HERMAN After Sales team:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
✍ fhservices@idexcorp.com

ES

Recomendaciones ATEX

Este equipo certificado ATEX cumple con los requisitos esenciales relativos a la seguridad y la salud en el diseño y la construcción del material utilizable en atmósferas potencialmente explosivas (Directiva 94/9/CE).

Para un uso seguro, compruebe que el equipo se utiliza según las indicaciones descritas en el certificado ATEX y la placa de identificación, y respete los manuales de utilización, de instalación y de mantenimiento del equipo y de los elementos que lo componen.

La instalación, utilización y el mantenimiento deben efectuarse por un personal cualificado que entienda por lo menos uno de los idiomas del manual.

Si le falta un manual o para cualquier información, contacte con el servicio de postventa de FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
✍ fhservices@idexcorp.com

IT

Raccomandazioni ATEX

La presente apparecchiatura è certificata ATEX e conforme alle esigenze essenziali nell'ambito della sicurezza e la salute per la concezione e la costruzione d'apparecchi destinati a essere utilizzati in atmosfere potenzialmente esplosive (Direttiva 94/9/CE).

Per un utilizzo altamente sicuro, accertatevi che l'apparecchiatura sia usata conformemente alle indicazioni fornite nel certificato ATEX e nella piastra d'identificazione; rispettate i manuali d'utilizzo, installazione e manutenzione dell'apparecchiatura e dei sottoinsiemi che la compongono.

L'installazione, l'utilizzo e la manutenzione vanno effettuati da un personale formato e specializzato, edotto di una delle lingue del manuale.

Se vi manca un manuale o per qualsiasi informazione, contattate il Servizio Clientela di FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
✍ fhservices@idexcorp.com

DA

ATEX anbefalinger

Dette udstyr er ATEX-certificeret og overholder de væsentlige sundheds- og sikkerhedsmæssige krav til design og konstruktion af apparater, der er beregnet til anvendelse i eksplosive atmosfærer (Direktiv 94/9/EF).

For en sikker anvendelse bør De sørge for, at udstyret anvendes i henhold til de forskrifter, der er defineret i ATEX-certifikatet og på identifikationsskiltet, og at bruger-, installations- og vedligeholdelsesvejledningerne for udstyret og de underenheder, det er sammensat af, overholdes.

Installationen, anvendelsen og vedligeholdelsen skal foretages af specialuddannet personale, som forstår et af de sprog, manualerne er udfærdiget på.

Hvis De mangler en manual eller for enhver anden information, kontakt venligst FAURE HERMAN's Serviceafdeling:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
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SV

ATEX rekommendationer

Denna utrustning är certifierad enligt ATEX och uppfyller de väsentliga kraven i fråga om säkerhet och hälsa vid utformning och tillverkning av apparater som är avsedda för användning i explosionsfarliga omgivningar (Direktiv 94/9/EG).

För en fullt säker användning, se till att utrustningen används i överensstämmelse med de anvisningar som figurerar i ATEX-certifikatet samt på identifikationsskylten, och följ instruktionsböckerna för användning, installation och underhåll av utrustningen och dess ingående underenheter.

Installationen, användningen och underhållet skall utföras av personal som är utbildad, specialiserad och som förstår något av instruktionsbokens språk.

Om du saknar någon av instruktionsböckerna eller för all annan information, kontakta FAURE HERMANs kundservice:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
✍ fhservices@idexcorp.com

NO ATEX anbefalinger

Dette utstyret er ATEX-sertifisert og oppfyller hovedkravene når det gjelder hensyn til sikkerhet og helse ved utforming og konstruksjon av utstyr til bruk i eksplosjonsfarlige omgivelser (Europaparlaments- og Rådsdirektiv 94/9/EF).

For full sikkerhet må det kontrolleres at utstyret benyttes i samsvar med anvisningene i ATEX-sertifikatet og på merkeplaten. Instruksjonene i brukerhåndbøker samt installasjons- og vedlikeholdsanvisninger for utstyret og delene det består av, må følges omhyggelig.

Installasjon, bruk og vedlikehold må utføres av spesialisert, faglært personell som forstår et av språkene i håndbøkene.

Hvis det mangler en håndbok eller hvis du trenger ytterligere opplysninger, vennligst ta kontakt med serviceavdelingen i FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
fhservices@idexcorp.com

NL ATEX richtlijnen

Deze apparatuur heeft de ATEX certificering en beantwoordt aan de essentiële eisen inzake veiligheid en gezondheid voor het ontwerp en de bouw van apparaten bedoeld voor gebruik op plaatsen waar ontploffingsgevaar kan heersen (Richtlijn 94/9/EG).

Voor een veilig gebruik dient u te controleren of de apparatuur gebruikt wordt volgens de in het ATEX certificaat vermelde aanwijzingen en op het kenplaatje en de gebruiks-, installatie- en onderhoudshandleidingen van de apparatuur en de samenstellende onderdelen in acht te nemen.

De apparatuur moet geïnstalleerd, gebruikt en onderhouden worden door speciaal hiervoor opgeleid personeel dat minstens één van de talen van de handleiding begrijpt.

Indien een handleiding ontbreekt of u aanvullende informatie nodig heeft, neem dan contact op met de servicedienst van FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
fhservices@idexcorp.com

PL Zalecenia ATEX

Niniejsze wyposażenie posiada certyfikat ATEX i jest zgodne z podstawowymi wymaganiami dotyczącymi bezpieczeństwa i higieny odnoszącymi się do projektu i budowy urządzeń przeznaczonych do użytkowania w przestrzeniach zagrożonych wybuchem (Dyrektywa 94/9/WE).

W celu zapewnienia bezpiecznego użytkowania, należy upewnić się, że wyposażenie jest używane zgodnie z zaleceniami podanymi w certyfikacie ATEX i na tabliczce znamionowej oraz należy przestrzegać zaleceń instrukcji obsługi, instalacji i konserwacji wyposażenia i jego podzespołów.

Instalacja, użytkowanie i konserwacja muszą być realizowane przez przeszkolony i wyspecjalizowany personel korzystający z dokumentacji przygotowanej w języku, jakim się posługuje.

W przypadku braku dostępu do danego podręcznika lub informacji, prosimy o skontaktowanie się z działem obsługi po sprzedaży FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
fhservices@idexcorp.com

DE ATEX Empfehlungen

Dieses Gerät ist ATEX-zertifiziert und entspricht den grundlegenden Sicherheits- und Gesundheitsanforderungen an Konstruktion und Bau für Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen (Richtlinie 94/9/EG).

Für eine sichere Anwendung muss das Gerät gemäß den Angaben im ATEX-Zertifikat und dem Typenschild verwendet werden. Berücksichtigen Sie die Gebrauchs-, Installations- und Wartungshandbücher des Geräts und dessen Komponenten.

Installation, Gebrauch und Wartung müssen von spezialisiertem Fachpersonal durchgeführt werden, die eine der Handbuchsprachen verstehen.

Wenn Sie ein Handbuch oder weitere Informationen benötigen, wenden Sie sich bitte an den FAURE HERMAN-Kundendienst

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
fhservices@idexcorp.com

PT Recomendações ATEX

Este equipamento é certificado ATEX e está conforme às exigências essenciais no que concerne a segurança e a saúde para a concepção e a construção de aparelhos destinados a serem utilizados em atmosferas potencialmente explosivas. (Directiva 94/9/CE).

Para uma utilização com total segurança, assegure-se de que o equipamento é utilizado de acordo com as indicações definidas no certificado ATEX e na placa de identificação, e respeite os manuais de utilização, de instalação e de manutenção do equipamento e dos subconjuntos que o compõem.

A instalação, a utilização e a manutenção devem ser realizadas por um pessoal formado e especializado que compreenda uma das línguas do manual.

Se faltar-lhe um manual ou para quaisquer informações, entre em contacto com o Serviço Após-Venda da FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
fhservices@idexcorp.com

FI ATEX-Suositukset

Tämä laite on ATEX-varmennettu ja vastaa turvallisuutta ja terveyttä koskevia oleellisia vaatimuksia koskien räjähdysvaarallisissa tiloissa käytettäväksi tarkoitettujen laitteiden suunnittelua ja valmistusta (Direktiivi 94/9/EY).

Turvallisuussyistä teidän tulee varmistaa, että laitetta käytetään ATEX-sertifikaatissa ja tunnistuslaatassa määriteltyjen ohjeiden mukaisesti ja teidän tulee noudattaa laitteen käyttö-, asentamis- ja huolto-ohjeita sekä laitteen että sen muodostamien osien ollessa kyseessä.

Asentamisen, käytön ja huollon saa toteuttaa ainoastaan koulutettu ja erikoistunut henkilökunta, joka ymmärtää jotain käyttöohjeissa käytettyä kieltä.

Jos teillä ei ole käyttöohjeita tai haluatte lisätietoja, ottakaa yhteyttä myynninjälkeishuoltoon FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
fhservices@idexcorp.com

EL

Συστάσεις περί ATEX

Ο παρών εξοπλισμός έχει πιστοποιηθεί ως ATEX και συμμορφώνεται με τις βασικές απαιτήσεις για την ασφάλεια και την υγεία σχετικά με το σχεδιασμό και την κατασκευή συσκευών που προορίζονται για χρήση σε εκρήξιμες ατμόσφαιρες (Οδηγία 94/9/ΕΚ).

Για λόγους ασφαλείας, βεβαιωθείτε ότι ο εξοπλισμός χρησιμοποιείται σύμφωνα με τις οδηγίες που δίνονται στο πιστοποιητικό ATEX και την πλακέτα αναγνώρισης και τηρήστε τις οδηγίες των εγχειριδίων χρήσης, εγκατάστασης και συντήρησης του εξοπλισμού και των υποσυνόλων που αποτελούν τον εξοπλισμό αυτό.

Η εγκατάσταση, η χρήση και η συντήρηση πρέπει να πραγματοποιούνται από καταρτισμένο και ειδικευμένο προσωπικό που κατανοεί μία από τις γλώσσες του εγχειριδίου.

Εάν χρειάζεστε κάποιο εγχειρίδιο ή για οποιαδήποτε άλλη πληροφορία, επικοινωνήστε με το Τμήμα Εξυπηρέτησης μετά την Πώληση της εταιρείας FAURE HERMAN:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
✍ fhservices@idexcorp.com

Protection hazardous area

The FH8500 counter can be used in hazardous areas:

- Protection of the enclosure containing the electronic boards: Ex d IIB T6 (flameproof enclosure, surface temperature which cannot exceed 85 °C)
- Protection of the enclosure containing the cabling connectors: Ex d IIB T6 (flameproof enclosure, surface temperature which cannot exceed 85 °C)
- Protection of the ultrasonic probes: Ex m II T6 to T4 (probes encapsulated, surface temperature which cannot exceed 85 °C to 135 °C, depending on the use conditions)
- Protection of the remote control: Ex ia IIC T4 (intrinsic safety, 2 possible faults, surface temperature which cannot exceed 135 °C)
- Protection of the supply and the instrumentation cables (part of customers' duty): the protection must be performed according to the local standards and rules. In particular, the cables must correspond to one of the following standards: IEC 60092-300 series / NEK600, BS 6883 / 7197, NF M 87-202.

> *Remark: The FH8500 is delivered with ATEX certificates and corresponding elements.*

ATEX recommendations

ATEX recommendations for FH8500 transducer

This equipment is ATEX certified and complies with the essential health and safety requirements relating to the design and construction of equipment intended for use in potentially explosive atmospheres (94/9/CE directive).

For a safety utilisation, be sure that you use this equipment in totally compliance with its ATEX certificate and nameplate indications, and respect the equipment user's manual and recommendations bellow.

Equipment nameplate

Refer to the equipment nameplate for operating field specifications.

ATEX nameplate on each equipment includes this kind of indications (example):

Company name:	FAURE HERMAN
Company address:	Route de Bonnétable 72400 La Ferté Bernard – France
Model:	USTT
Serial number	S/N…
Manufacturing year:	Year
CE Logo:	CE
Notified organism number:	0081
ATEX marking:	
Equipment category:	II 2 G
Protection type:	Ex m
Gas classification:	None
Temperature classification:	T6 to T4
ATEX agreement number:	LCIE 03 ATEX 6239 X
Do not open while energized	
Ue	±400V
Pe	1W

The equipment can also carry the usual marking required by the manufacturing standards applying to such equipments.

Installation

WARNING:	This equipment is suitable in hazardous area complying with the indications specified on its nameplate (Hazardous location information, operating conditions and restrictions, specific installation …).

CAUTION:	Handle the equipment with care and Select a mounting location so that the equipment will not be subjected to impact by heavy objects. Impacts can damage the equipment.

WARNING:	Electrical power must be "OFF" before and during installation

WARNING:	The equipment shall be installed by means of the suitable tools. Never use a hammer or impact wrench.

WARNING:	If this equipment is supposed to be connected to other devices, verify that the protection systems are compatible.

Maintenance

WARNING:	Electrical power must be "OFF" before and during Maintenance

WARNING:	Always disconnect primary power source before opening equipment for inspection or service

WARNING:	Maintenance operation shall be done by means of the suitable tools. Never use a hammer or impact wrench.

- Frequent inspection should be made. A schedule for maintenance checks should be determined by the environment and frequency of use.
- Perform visual, electrical and mechanical checks on all components on a regular basis.
- Visually check for undue heating evidenced by discoloration of wires or other components, damaged or worn parts or leakage evidenced by water or corrosion in the interior.
- Electrically check to make sure that all connections are clean and that the device is operating properly.

For specifically installation and maintenance advices, contact FAURE HERMAN After Sales Department:

FAURE HERMAN
Route de Bonnétable – 72400 LA FERTE BERNARD
☎ +33 (0)2 43 60 28 80 - 🖷 +33 (0)2 43 60 28 89
🖉 services@idexcorp.com

Don't forget to give us your equipment serial number.

ATEX recommendations

ATEX recommendations for FH8500 electronic enclosure

This equipment is ATEX certified and complies with the essential health and safety requirements relating to the design and construction of equipment intended for use in potentially explosive atmospheres (94/9/CE directive).

For a safety utilisation, be sure that you use this equipment in totally compliance with its ATEX certificate and nameplate indications, and respect the equipment user's manual and recommendations bellow.

Equipment nameplate

Refer to the equipment nameplate for operating field specifications.

ATEX nameplate on each equipment includes this kind of indications (example):

Company name:	FAURE HERMAN
Company address:	Route de Bonnétable 72400 La Ferté Bernard – France
Model:	ADS8500
Serial number	S/N…
Manufacturing year:	Year
CE Logo:	CE
Notified organism number:	0081
ATEX marking:	Ex
Equipment category:	II 2 G
Protection type:	Ex d
Gas classification:	IIB
Temperature classification:	T6
ATEX agreement number:	LCIE 03 ATEX 6356 X
Do not open while energized	

The equipment can also carry the usual marking required by the manufacturing standards applying to such equipments.

Installation

WARNING:	This equipment is suitable in hazardous area complying with the indications specified on its nameplate (Hazardous location information, operating conditions and restrictions, specific installation …).

CAUTION:	Handle the equipment with care and Select a mounting location so that the equipment will not be subjected to impact by heavy objects. Impacts can damage the equipment.

WARNING:	Electrical power must be "OFF" before and during installation

WARNING:	The equipment shall be installed by means of the suitable tools. Never use a hammer or impact wrench.

WARNING:	If this equipment is supposed to be connected to other devices, verify that the protection systems are compatible.

Maintenance

WARNING:	Electrical power must be "OFF" before and during Maintenance

WARNING:	Always disconnect primary power source before opening equipment for inspection or service

WARNING:	Maintenance operation shall be done by means of the suitable tools. Never use a hammer or impact wrench.

- Frequent inspection should be made. A schedule for maintenance checks should be determined by the environment and frequency of use.
- Perform visual, electrical and mechanical checks on all components on a regular basis.
- Visually check for undue heating evidenced by discoloration of wires or other components, damaged or worn parts or leakage evidenced by water or corrosion in the interior.
- Electrically check to make sure that all connections are clean and that the device is operating properly.

For specifically installation and maintenance advices, contact FAURE HERMAN After Sales Department:

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🖉 fhservices@idexcorp.com

Don't forget to give us your equipment serial number.

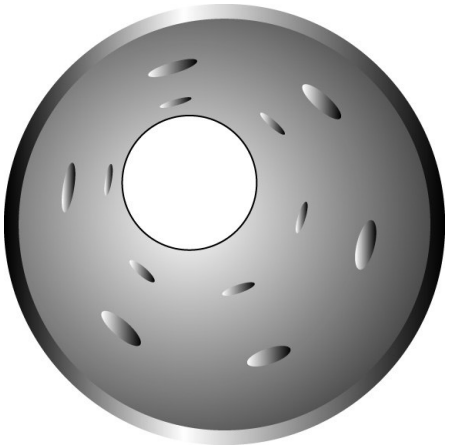
Chapter 1: General overview

The FH8500 is the only 18-path ultrasonic flow meter - volume counter specially designed for custody transfer measurements of fluids such as crude oil or refined products, according to the recommendations of both OIML (International Organization of Legal Metrology) R117 Class 0.3 and API (American Petroleum Institute) chapter 5.8 of the Manual for Petroleum Measurement Standard (MPMS). In particular, the measuring error, compared with a proving device, is guaranteed to be inferior to ±0.15 % for a flow range from 1 m/s to 15 m/s [1] . (Please, contact Faure Herman for flow velocities beyond this range.)

Remark: The FH8500 is delivered with an individual calibration certificate.

Measuring principle

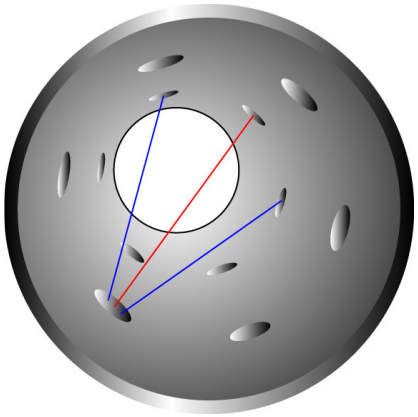
The FH8500 is equipped with 12 ultrasonic transducers divided into two sets (6 transducers per set).

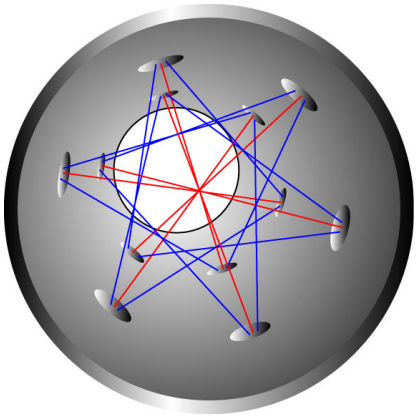


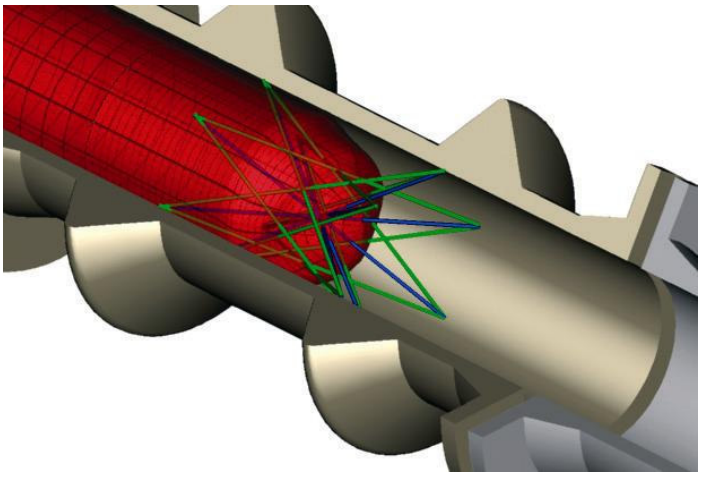
Note: The figure shows only the transducer seatings.

(1) The API recommendations are more restrictive than the OIML's ones, which recommends an 0,2 % – class 3 error.

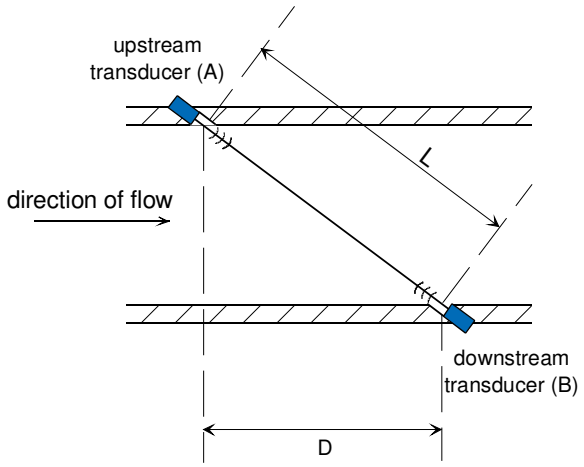
Each transducer is composed of 3 ultrasonic elements alternatively transmitting and receiving an ultrasonic wave in 3 directions, the 6 x 3 paths representing a "tri-dimensional star".







The velocity of flow along the path between two paired transducers is determined by the method called "transit time difference method" based on the expression below:



$$V = \frac{L^2}{2D} \cdot \frac{\Delta T}{T_{AB} \cdot T_{BA}} \qquad \text{where} \quad \Delta T = T_{BA} - T_{AB}$$

(T_{AB}: transit time of the ultrasonic wave from the upstream transducer to the downstream; T_{BA}: transit time of the ultrasonic wave from the downstream transducer to the upstream.

Remark: The expression above is independent of the velocity of sound inside the product flowing in the pipe.
This velocity can be computed by the meter by using the following expression:

$$C = \frac{L}{2}\left(\frac{1}{T_{AB}} + \frac{1}{T_{BA}}\right)$$

The tri-dimensional configuration generated by the 18 paths allows to free oneself from almost any kind of swirls or asymmetric, turbulent or laminar flows and then to obtain a high quality measurement to a great extent independent on the flow conditions. (A single-path measurement depends noticeably on

the regularity and symmetry of the flow. The greater number of paths is, the less the dependence of the measurement on the flow velocity profile will be.)

Sizes and Flowrates

Faure Herman offers 10 standard diameter versions, from 4" (DN100) to 24" (DN600), except 22". See in Appendix I the dimensions and weight of each of these counters.

Standard K-factors

The factory set K-factors are, depending on the size:

FH8500 diameter	Pulses / m3	Pulses / barrel
4" (DN100)	32 000	5 000
6" (DN150)	16 000	2 500
8" (DN200)	8 000	1 300
10" (DN250)	6 000	1 000
12" (DN300)	4 000	650
14" (DN350)	3 000	480
16" (DN400)	2 200	350
18" (DN450)	1 600	250
20" (DN500)	1 400	220
24" (DN600)	1 000	160

Remark: For a given size, the recommended K-factor has been adjusted to provide the best repetability of the measurement.

Working modes

The FH8500 can operate in two modes: custody transfer mode and non custody mode

- In custody transfer mode, only the parameters which have no influence on the measurement (display units and units used for the 4-20 mA outputs and the alarms, parameters concerning the different inputs - outputs…) can be modified.

- The non custody transfer mode allows to stop the meter and to set all the parameters, except the factory ones (meter diameter, calibration coefficients, temperature correction factor of the diameter) which can be only read.

The changeover between these two modes is done by a switch located in the sealed enclosure containing the electronics.

Constitutive parts of the FH8500

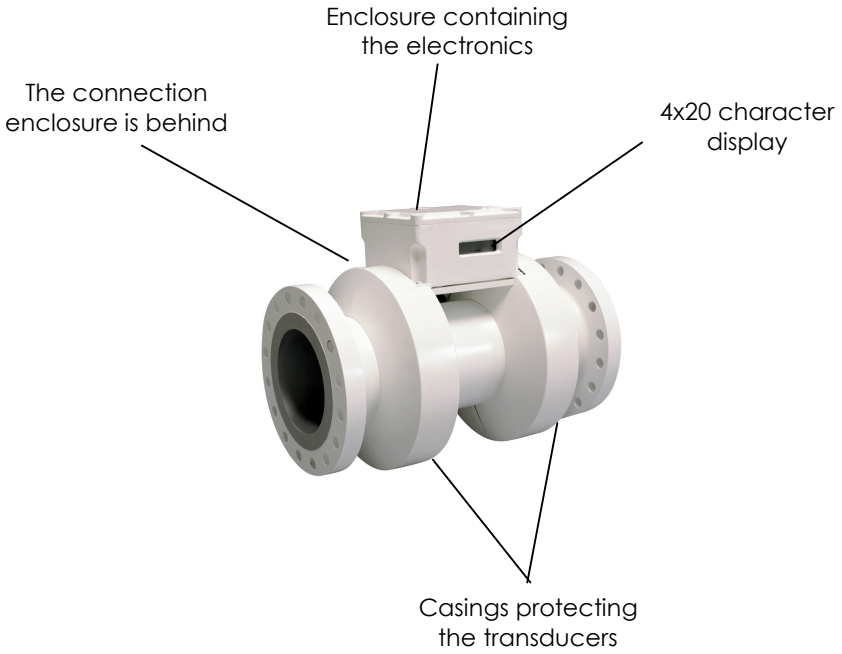
A FH8500 includes the following main elements (see figure on next page)

- a flanged body
- two sets of 6 transducers, each set being protected by a casing.
- an explosion-proof enclosure containing the electronic boards and equipped with a 4-lines – 20 characters display

> **Important**: In custody transfer counting, this enclosure is sealed and can be opened only by an authorized person.

- an explosion-proof enclosure containing the cabling connectors
- an intrinsically safe infrared remote control allowing the meter parameter setting

> *Remark*: The parameter setting can also be done by means of the Faure Herman FHview PC software or a control-command device linked to the FH8500.



FH8500 inputs-outputs

The FH8500 is equipped with the following inputs-outputs:

- two 4-20 mA analog inputs for the temperature and pressure measurements
- two $\pi/2$ phase-shifted pulse outputs, which can be either TTL type or open collector type, for the volume counting (in custody transfer counting, only these outputs are considered as being authentic)

  Pulse outputs characteristics:
  - In TTL mode : 5 V max, 1 mA max, 10 kHz max
  - In open collector mode : 30 V DC max, 500 mA max, 300 mW max, 10 kHz max, 5 kV AC or DC opto-insulation
- three 4-20 mA analog outputs for the recopy of variables such as flow-rate, volume, velocity of flow, velocity of sound

- two Reed-type contacts for alarms (for instance, an alarm can be allocated to the velocity of sound in order to indicate a product change in the pipe)
- RS485 serial link (or a Hart link using the analog output n° 1 (1)) allowing the data and parameters transmission to a control-command system as well as the remote parameter setting

Data logger and Event logger

The FH8500 includes two loggers: Data logger and Event logger.

The Data logger records in a non-volatile memory (1 024 available records), with a storage period which can be chosen from 1 s to 24 h, some measurement data as the counting mode, the flow-rate value, the velocity of flow (see in page 81 the complete list of stored data).

Remark: The total recording duration depends on the selected period. The table below gives the recording duration for several period values.

Recording period	Total available recording duration
1 s	≈ 17 mn
10 s	≈ 2 h 50 mn
1 mn	≈ 17 h
10 mn	≈ 7 days and 2 h 25 mn
1 h	≈ 42 days and 16 h
24 h	≈ 2 years and 292 days

(1) The two modes of link are exclusive : either RS485-Modbus link or analog output n° 1 - Hart link.

The event logger records in a non volatile memory (1 024 available records) some events such as the FH8500 power on or off, the change of state of the alarms, the changeover from a counting mode to another (see page 85 the complete list of recorded events).

Both Data and Event loggers can be read by means of either FHview software or any DCS (Distributed Control System) linked to the FH8500.

The reset of both loggers can be individually done by means of the remote control device, the FHview software or DSC.

> *Remark: Both loggers operate according to the cyclic memory principle: when all the available records are used, the most recent records erase the oldest ones.*

Maximum line pressure

The FH8500 is designed for a line pressure of 100 bar max (1,450 psi).

> *Remark: Refer to Appendix V for pressure temperature rating as a function of body material (ASME B16.5-2003 – Tables 2-1.1, 2-1.2, 2-2.2).*

Pressure drop

The FH8500 is a full bore flowmeter which does not generate pressure drop.

Using the FH8500 in a vertical pipe

The FH8500 can be installed on a vertical pipe without restriction.

Power supply

The FH8500 can equally be supplied with a 110 - 220 V AC / 50 - 60 Hz power supply. (The voltage and frequency are automatically recognized. Then, no specific cabling is needed.)

Consumption for both voltages: 25 W

Other characteristics

- Repeatability: typically, 0.05 % for 5 runs

> *Remark: The repeatability is defined by API as being, for several consecutive runs performed at a given measurement, the ratio*
>
> $$\frac{\textit{value max - value min}}{\textit{value min}}$$
>
> *(See the 5.8 chapter of the MPMS)*

- Ambient temperature: from -40 to +60 °C (-40 to +140 °F)
- Fluid temperature: from -40 to +120 °C (-40 to +248 °F)
- Fluid kinematic viscosity: from 0,2 to 500 cSt (greater on demand)
- Fluid density: from 400 to 1 500 kg/m^3
- Ingress Protection : IP66
- Available flanges: #150 (ISO PN 20), #300 (ISO PN 50), #600 (ISO PN 100), #900 (ISO PN 150) with, in any case, a maximum line pressure of 100 bar

> *Remark: For all the FH8500 models, the body is made by casting.*

- EMC according to EN 50081 and EN 50082-2 standards
- Back-up battery allowing data and parameter storage during at least 10 years
- Material used for the meter body: stainless steel ASTM A351 CF8M (ASTM A 182 F 316 in wrought version) and carbon steel ASTM A 216WCB (ASTM A 105 in wrought version)
  (Other materials may be available upon request)
- Material used for both electronic enclosures: Cast steel
- Model approval:
  - Gost (Russia): n° 11397
  - PTB : (Germany): n° 5.722-02.02
  - ONML (Algeria): 021 / DIR / ONML / 04

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Chapter 2:
Commissioning procedure

FH8500 handling

Like any measurement device, the FH8500 must be handled with the greatest care.

The handling must be done as follows:

- With lifting rings fitted on the FH8500, for equipments with a weight > 35 kilos
- Or with straps on both sides of the flowmeter body when there are no lifting rings

> **Important**: Follow the handling recommendations as described in Appendix VI.

Reception and storage

- ❑ Check the general appearance of the packing and FH8500 in order to identify possible damages inflicted during transportation.
- ❑ Before installing the equipment, it is recommended to keep it in its initial packing.
- ❑ The flanges of the FH8500 equipped with protection covers which must be removed only during its installation on the pipe.
- ❑ Store the FH8500 in a dry and clean place. The storage temperature should be between -40 and +60 °C (-40 and 140 °F)
- ❑ In case of extended storage (typically more than one year), we recommend to check on a bench the calibration curve of the meter.

Choice of the FH8500 location on the pipe

Faure Herman recommends an upstream straight length of 20 times the pipe diameter (20D) without flow straightener or a 10D straight length with a flow straightener upstream.
The downstream recommended straight length is equal to 5D min.
(A straight length is a pipe portion sufficiently free from any disturbance such as bends, valves, etc.)

Please, contact Faure Herman so as to determine the most suitable flow straightener with regard to your application.

Installing the FH8500

- Gasket according to NF EN 12560 standard shall be used. The spiral Wound Gaskets are forbidden for flanges class 300 (PN50).
- The material of the flange bolting shall be chosen in ASTM A 193 B7 according to NF EN ISO 898-1 standard for temperature between -45°C and +480°C.
- The tightening couple is provided by the table of Appendix VI page **Erreur ! Signet non défini.Erreur ! Signet non défini.**.
- Check that the meter and the pipe are correctly aligned. – See Appendix VI page 102 for details

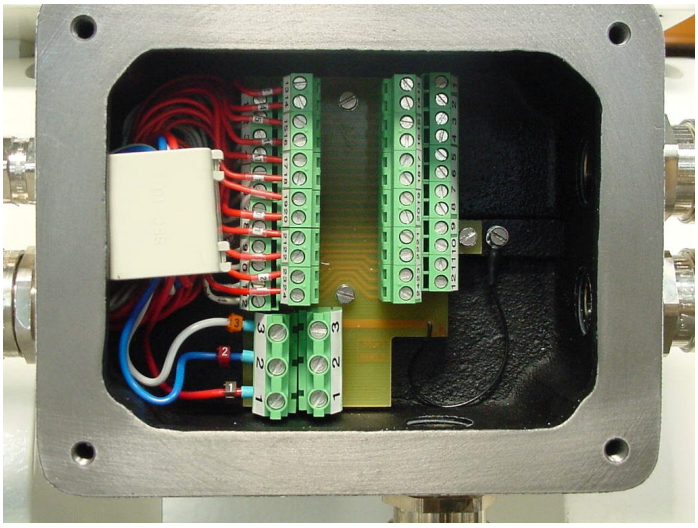
> *Remark: Both flanges have a slightly conical edge allowing to correct a difference of thickness (schedule) or alignment between the pipe and the meter.*

- Before installing the meter on the pipe, carefully check the cleanliness of flanges in order to obtain an absolute tightness between meter and pipe.
- Check that the meter positioning does not cause any traction effort on cables.

Cabling the FH8500

Open the cabling enclosure by unscrewing the four bolts fastening the cover (by using a 6 x 10 mm side spanner)

The cabling enclosure includes 2 x 3 connectors:

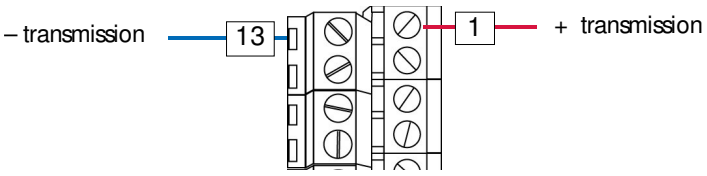


- The left-side connectors are wired by Faure Herman and must not be manipulated.
- The two upper-right connectors are dedicated to the instrumentation cables.
  The right connector includes the 1 to 12 terminals and receives the inputs-outputs + wires.
  The left connector includes the 13 to 24 terminals and receives the inputs-outputs – wires.
- The lower-right connector receives the power supply cable and the shielding.

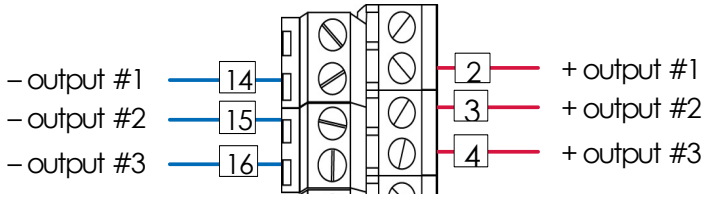
Important: The 7, 19, 12 and 24 terminals are reserved for a later use and then should not be wired.

Remark: The cabling enclosure includes three glands: two 1/2 " glands for the instrumentation cables and one 1/4 " gland for the power supply cable.

Cabling the RS 485 link

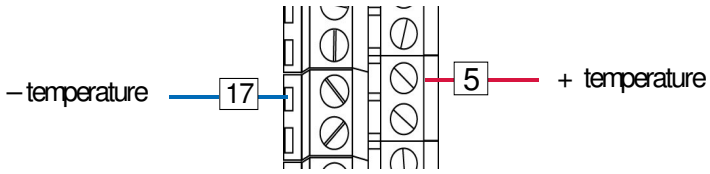


Cabling the 4-20 mA ouputs

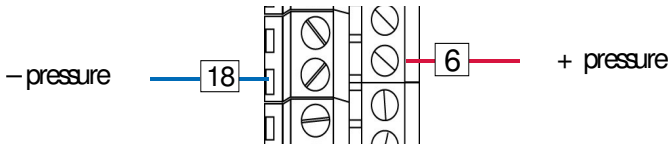


Note that 4-20mA outputs are passive.

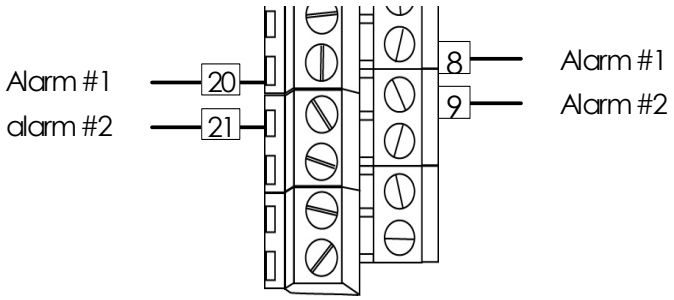
Cabling the temperature input



Wiring the pressure input

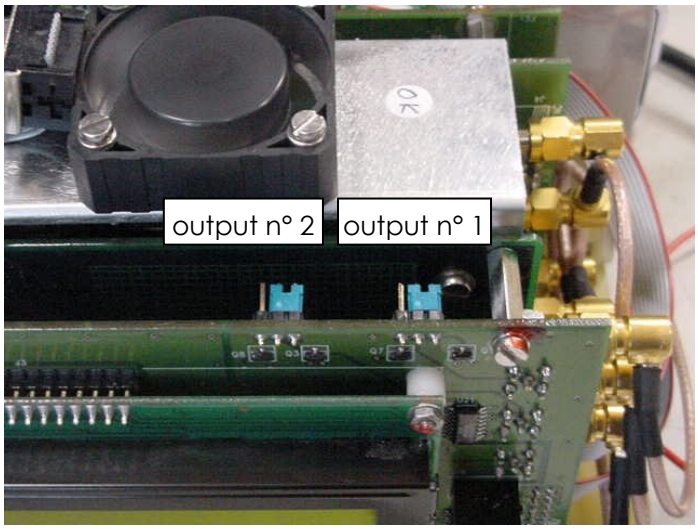


Wiring the alarms



Selection of the pulse outputs working mode

The working mode of each pulse output is defined by a jumper (U-shaped wire) located on the electronic board controlling the display.



When you face the display:

- Output in TTL mode: jumper placed on the two right pins
- Output in open collector mode: jumper placed on the two left pins

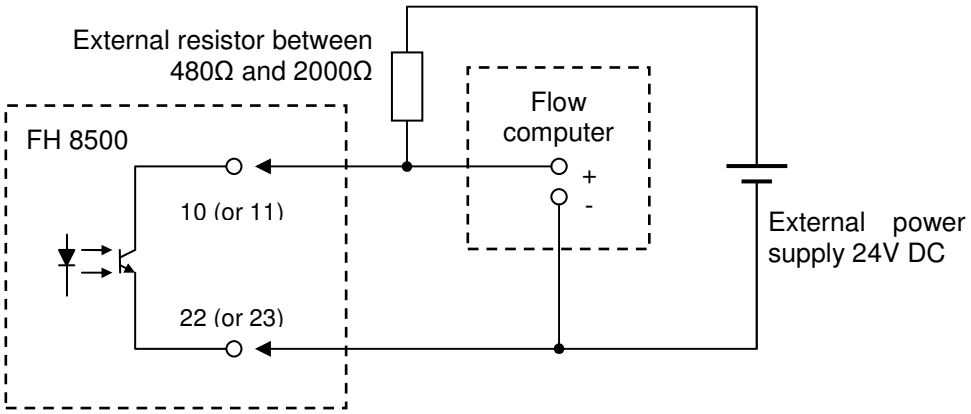
Remarks:

1) Removing a jumper leads to the disconnection of the corresponding output.

2) On delivery, the pulse outputs are set according to the customer demand. By default, the pulse outputs are set in the TTL mode.

Connecting scheme for a pulse output

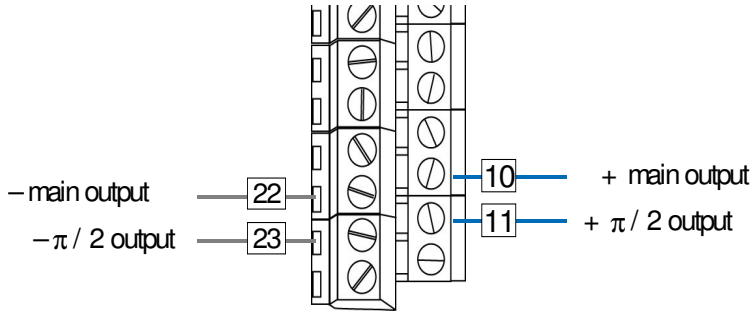
The diagram below shows a typical connection of a pulse output:



Pins 22 and 23 are connected together and are at the reference potential of the Modbus output.

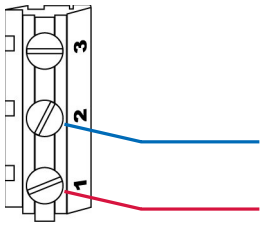
Check the correct compatibility of the potentials when several of these outputs are used simultaneously.

Cabling the pulse outputs



Important: For both working modes (TTL or open collector), the indicated above polarity must be imperatively applied. A polarity mistake may damage or even destroy the pulse outputs.

Wiring the power supply



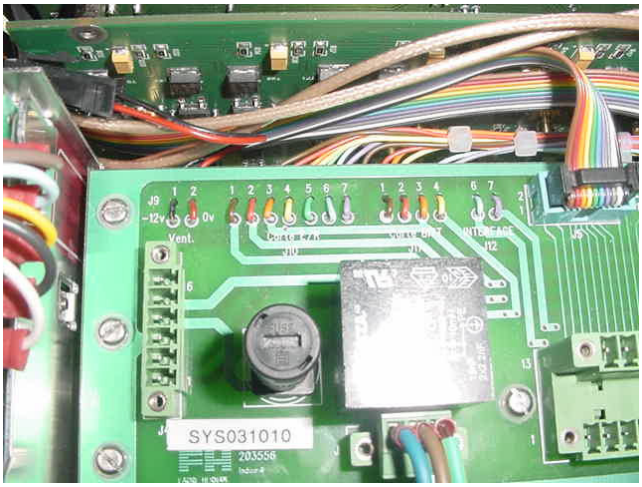
Neutral

Live wire (110 ou 220 V)

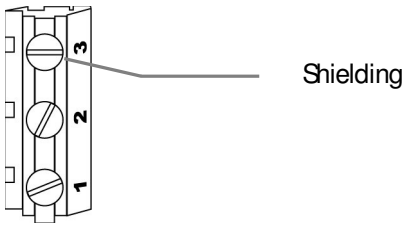
Remarks:

1) The power supply cable must be a 0,6mm²/1 kV cable = AWG 19.

2) The FH8500 is protected by a 5x20mm 500 mA delay fuse located in the enclosure containing the electronic boards.



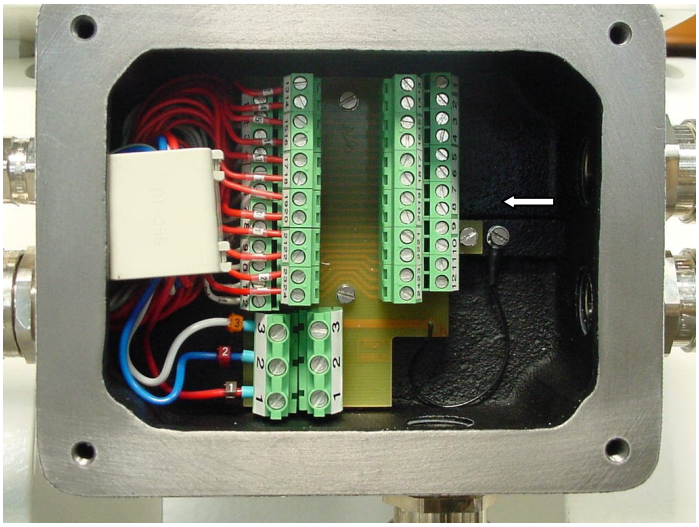
Wiring the shielding



Earthing of the meter to the pipe

As the meter's electronics is floating-potential designed, the meter can be connected to the pipe (without risk of damage in the case of pipe with cathodic protection).

For connecting the meter to the pipe, screw the end of the small black wire of the connection enclosure.



(If this wire is disconnected, the meter works in floating potential.)

Chapter 2: Commissioning procedure

Setting the FH8500's parameters

The FH8500 parameter setting is described in the next chapter.

Commissioning of the plant

Make sure that measurement is not altered by gas pockets or bubbles as well as particles in suspension. (The gas pockets or bubbles and the particles in suspension impede the propagation of ultrasonic waves. If their number is too large, the measurement may become non valid.).

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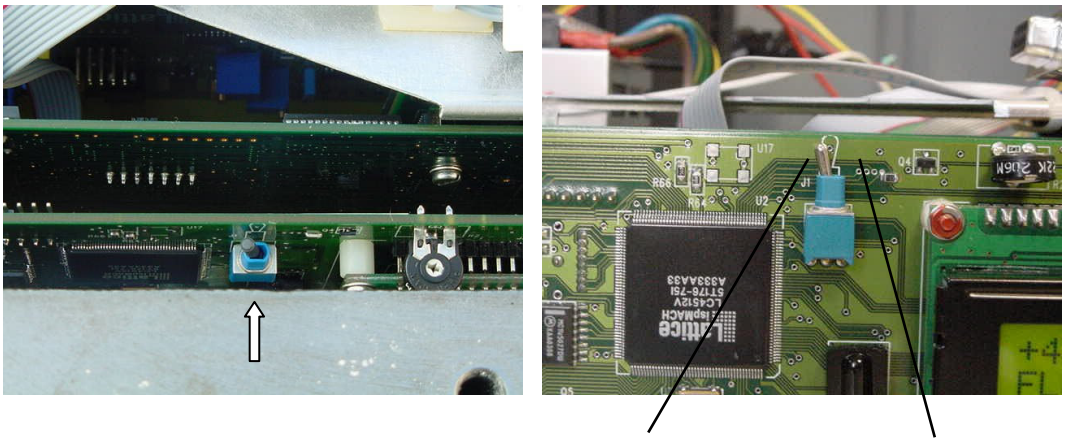
Chapter 3:
Using the FH8500 remote control device

The parameter setting of the FH8500 can be achieved by means of the remote control device delivered with the FH8500 or the FHview PC software.

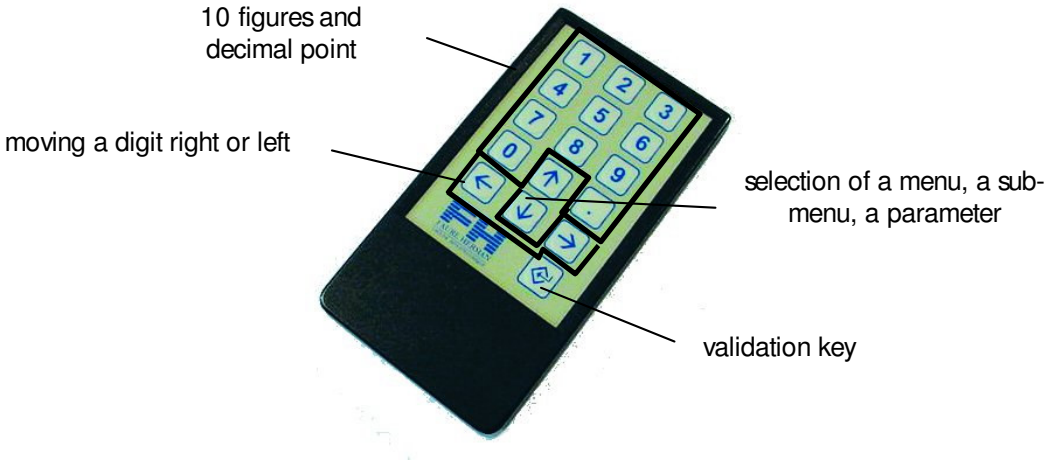
The extent of the parameter setting depends on the custody transfer or non custody transfer mode of the meter.

> *Reminder: The custody mode allows to set the only parameters which have no influence on the measurement. The non fiscal mode allows to stop the meter and modify all the parameters except the ones set by Faure Herman (inside diameter and calibration coefficients).*

The changeover between these two modes is done by a switch located at the rear side of the board controlling the display.



Remote control device's keypad



Information displayed in measure mode

In measure mode, the screen displays the following information

- Number of paths in operation
- Velocity of sound
- Temperature
- Pressure
- Flow rate
- Volume

The first four indications are displayed alternately (number of valid paths and velocity of sound; temperature and pressure).

Flow rate and the volume are displayed permanently.

Chapter 3: Using the FH8500 remote control device

General parameter setting procedure

From the local display, enter the parameter setting mode by pressing the Enter key of the remote control device.

Use the ↑ and ↓ keys for selecting a sub-menu or a parameter.

The selected option is indicated by an → arrow on the left of the item. The parameters stored in the FH8500 are indicated by a * character.

For the numerical values, select the value of each digit separately. (The sign is modified by means of the ↓ and ↑ keys).

Press the Enter key to validate the selected parameter or value.

> *Remark: Each parameter setting screen includes an "Exit" line and a "Stop" / "Start" line. (The "Stop" / "Start" line is displayed only when the FH8500 is in non custody transfer mode.)*
> *The "Exit" line allows to return into the measure mode display.*
> *The "Stop" / "Start" line allows to stop and restart the meter. (The stopping and restarting of the meter are recorded in the Event logger.)*

Principle of menus and sub-menus numbering

Each menu or sub-menu is numbered by means of a 1, 2, 3 or 4 figure number.

Example: The 113 menu corresponds to the following arbo-rescence:

1. Settings

11 4/20 + Alarm units

113 Volume

> **Important**: The sub-menus of the 2nd, 3rd and 4th levels are numbered from 0.

Menus and sub-menus structure

"1 Settings": Setting of the parameters having no influence on the measurement

- "10 Display units": Selection of the display units
- "11 4/20 + Alarm units": Selection of the units used for the analog outputs and alarms

> *Remark: It is possible to define separately the display units and the units used for 4-20 mA outputs and the alarms.*

- "12 Set 4/20 Outputs": Allocation of the analog outputs and calibration of the corresponding 4 and 20 mA limits
- "13 Set T Input": Calibration of the 4 and 20 mA limits of the temperature input
- "14 Set P Input": Calibration of the 4 and 20 mA limits of the pressure input
- "15 Set Alarms": Setting of the alarms
- "16 Set Serial bus": Setting of the serial link
- "17 Set Loggers": Selection of the Data logger storage period and reset of the Data or Event loggers
- "18 Real Time Clock": Updating of the date and time
- "19 Set Backlight": Setting of the backlight

"2 Reset Totalizer": Reset the Volume totalizer

"3 Corrected diameter": value of the inside diameter (in mm, with a 1 µm resolution) according to the temperature

"4 Serial Number": Display of the FH8500 serial number

"5 Configuration": Setting of the measurement parameters (parameters modifiable only in non custody transfer mode after a meter stop)

- "50 Calibration" : Definition of the damping (filter time constant) and display of the factory set parameters
- "51 Set Pulse Output" : Definition of the K-factor unit, definition of the K-factor

"6 Zeroing": Adjustment of the zero, normally achieved in factory and accessible only in non custody transfer mode after a meter stop

Selection of units

Display unit for the flow rate

"100 Flowrate" menu

– Possible units: m^3/h ; m^3/mn ; m^3/s ; l/h ; l/mn ; l/s ; gpm (gallon per minute) ; bph (blue barrel per hour)

Display unit for the temperature

"101 Temperature" menu

Possible units: °C ; °F ; K

Display unit for the pressure

"102 Pressure" menu

Possible units: bar ; kPa ; psi

Display unit for the totalizer

"103 Totalizer" menu

Possible units: m3 ; l ; gal ; bbl (blue barrels)

Display unit for the velocity of sound

"104 VOS" menu

Possible units: : m/s ; ft /s

Transmission unit for the velocity of sound

"110 V.O.S" menu

Possible units: m/s ; ft /s

Transmission unit for the velocity of flow

"111 V.O.F" menu

Possible units: m/s ; ft /s

Transmission unit for the flow rate

"112 Flow rate" menu

Possible units: m^3/h ; m^3/mn ; m^3/s ; l/h ; l/mn ; l/s ; gpm ; bph

Transmission unit for the totalizer

"113 Totalizer" menu

Possible units: m3 ; l ; gal ; bbl

Transmission unit for the pressure

"114 Pressure" menu

Possible units: bar ; kPa ; psi

Transmission unit for the temperature

"115 Temperature" menu

Possible units: °C ; °F ; K

Setting the analog outputs

Allocation of the output n° 1

"1200 Set 04-20 Var" menu

The output n° 1 can be allocated to one of these variables:

- Velocity of sound
- Velocity of flow
- Flow
- Totalizer
- Pressure
- Temperature
- Gain

  The gain corresponds to the average value, for the paths in operation, of the attenuation of ultrasonic waves through the fluid.

  The acceptable values go from -2 dB (not very attenuated signal; risk of saturation above) to -45 dB (strongly attenuated signal; risk of interference below)

Calibration of 4 and 20 mA limits of the analog output n° 1

"1201 Set 04 mA Value" and "1202 Set 20 mA Value" menus

Setting of the analog output n° 2

1210, 1211 and 1212 menus

See above

Setting of the analog output n° 3

1220, 1221 and 1222 menus

See above

Setting the temperature input

"130 Set 04 mA Value" and "131 Set 20 mA Value" menus

Define the values corresponding respectively to 4 and 20 mA, the unit being the one defined in the "115" menu.

Setting the pressure input

"140 Set 04 mA Value" and "141 Set 20 mA Value" menus

Define the values corresponding respectively to 4 and 20 mA, the unit being the one defined in the "114" menu.

Setting the alarms

Allocation of the alarm n° 1

"150 Set Alarm1 Var" menu

The alarm can be allocated to one of these variables:

- Velocity of sound
- Velocity of flow
- Flow rate
- Volume
- Pressure
- Temperature
- Gain
- Number of paths in operation (opening of the contact if the number of paths in operation becomes inferior to this value)

  In theory, as the meter is calibrated with all the 18 paths in operation, the loss of only one path may lead to an error outside the ±0,15 % interval.

In practice, the tests which have been performed by a third party have shown that the meter error remains within the ±0,15 % limits with up to 15 paths in operation.

Switching mode of the alarm n° 1

"151 Set Alarm1 Lim" menu

Possible choices: < and > (except for the alarm allocated to the number of paths in operation where comparison corresponds systematically to <)

The alarm is active (opening of the contact) when the parameter value becomes inferior or superior to the value defined in the 152 menu.

Threshold of the alarm n° 1

"152 Set Alarm1 Val" menu structured as follows:

<Variable allocated to the alarm> Limit Value
<threshold value> <unit defined in the 11 menu>

Summary of the alarm n° 1

"153 Alarm1 registered" menu

Setting of the alarm n° 2

154, 155, 156 and 157 menus corresponding respectively to the 150, 151, 152 and 153 menus

Setting the serial link

Selection of the link protocol

"160 Modbus / Hart" menu

In Modbus link, the FH8500 works in slave mode (query by the device linked to the FH8500, response by the FH8500)

Modbus protocol baud rate

"161 Modbus Baudrate" menu (displayed only if the selected protocol is Modbus)

Possible choices: 9,600 and 19,200 bauds

Make sure that both equipments (FH8500 and control-command system) have the same baud rate.

> *Remark: If the Hart protocol is selected, the transmission rate is set to 1,200 bauds.*

Modbus slave number

"162 Modbus address" menu (displayed only if the selected protocol is Modbus)

Setting the data logger and resetting both loggers

Choosing the data logger storage period

"170 Set Data Freq" menu

Possible values: 1 s ; 5 s ; 10 s ; 30 s ; 1 min ; 2 min ; 5 min ; 10 min ; 15 min ; 30 min ; 1 hr ; 2 hrs ; 6 hrs ; 12 hrs ; 24 hrs

Resetting the Data Logger

"171 Clear Data Log" menu

Resetting the Event logger

"172 Clear Event Logger" menu

Setting FH8500 date and time

Setting the date

"180 Date Setting" menu

The date is stored and displayed in the international format : dd / mm / yy

> *Remark: Day, month and year must be validated separately.*

Setting the time

"181 Clock Setting" menu

The time is stored and displayed in the format hh : mm.

Setting the back-light

"19 Set Backlight" menu

Possible choices:

- On (permanent backlight)
- Off (backlight switched off)
- Timer (backlight switched on during about 10 s after pressing a key of the remote control)

Resetting the totalizer

"2 Reset Totalizer" menu

Display of the temperature corrected inside diameter

"3 Corrected diameter" menu

The value of the temperature corrected inside diameter is given in mm, with a resolution of 1 µm.

Display of the serial number

"4 Serial Number"

The serial number comprises up to 20 characters.

Time constant of the floating average filter

"500 Damping" menu

Indicate the number of flow measurements used for the calculation of the average flow rate. (The average flow rate is displayed by the FH8500 and is used for the pulse outputs, the analog outputs and the alarms, and is transmitted via the serial link.)

The greater the "Damping" parameter is, the more filtered the fluctuations and fast variations are.

Factory set parameters

The calibration coefficients (501 menu), the inside diameter (502 menu) and the diameter temperature correction factor (503 menu) can only be displayed.

Setting the K-factor

K-factor unit

"510 Set KF Unit" menu

Possible choices: pulses / m^3 ; pulses / litre ; pulses / gallon ; pulses / barrel

Value of the K-factor

"511 Set KF" menu

Indicate the K-factor value (number of pulses per volume unit) according to the unit selected in 510 menus.

Zeroing

"6 Zeroing" menu

The FH8500 zero (nil flow rate value for a nil flow) is set in factory. On site zeroing must be done only by Faure Herman or by an authorized operator.

Chapter 4:
Spare parts and Maintenance

The FH8500 ultrasonic flow meter is a maintenance-free instrument, mainly because it does not have any moving part. However, it might happen that users have to replace either transducers or electronics.

Warning: The replacement of both electronics and transducers requires turning off the power supply. Once power supply is off, wait at least one minute before opening the converter's enclosure.

Spare parts

To reduce the downtime period which might be due to either transducer or electronics failures, Faure Herman recommends the following spare parts:

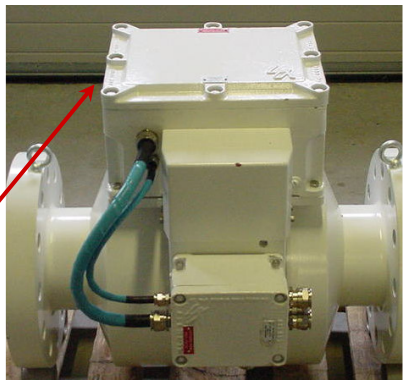
- A transducer set (transducer, wire, cable gland, etc.)
- A full electronics set

> **Important**: The replacement of the electronics must be done by a Faure Herman technician.

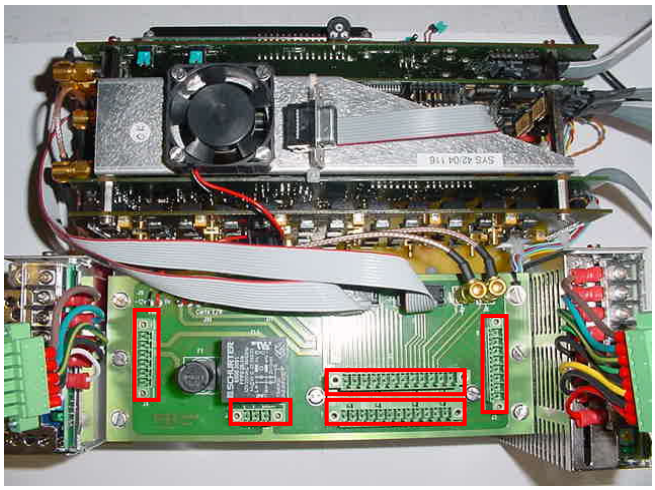
1. Replacing the converter's electronics

Removing the electronics

- **Turn off the power supply.**
- If necessary, unseal the converter's enclosure.
- Unscrew and remove the cover.

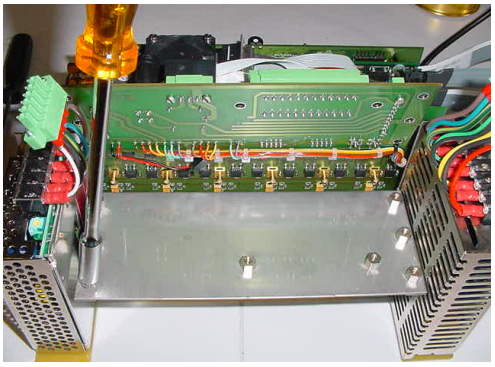


- Disconnect the 5 terminal strips, as shown, from the connecting board.

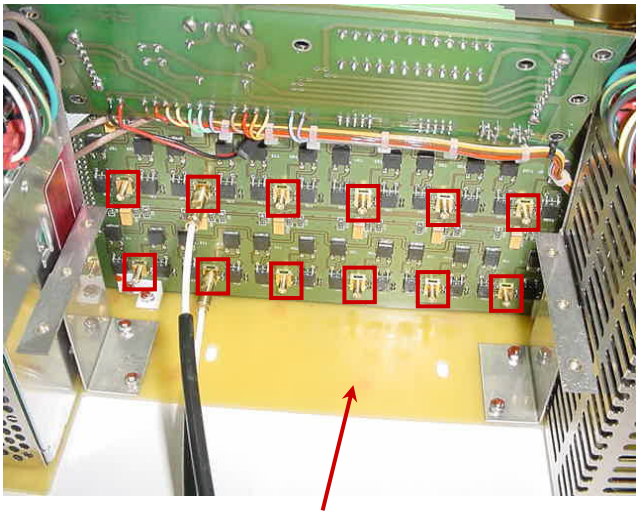


Unscrew and remove the connecting board.

- Unscrew and remove the stainless steel plate.



- Disconnect carefully all 12 transducers' cables.



- Unscrew the epoxy base plate (this base plate is fastened by 3 screws) and remove carefully the complete electronic set.

Installing a new converter's electronics

- Prepare the new electronic plate.
- Install and screw the electronics block (3 screws).
- Connect the transducers' cables.
- Install and screw the stainless steel plate.
- Install and screw the connecting board.
- Connect terminal strips on the connecting board.
- Close the converter and screw the cover (Apply silicone grease on seal surface. We recommend the use of silicone grease DOW CORNING DC4).

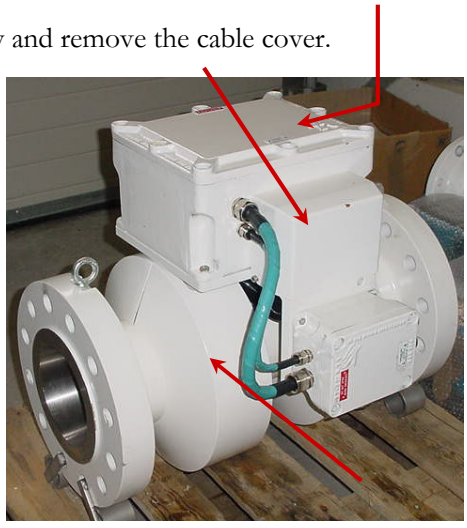
2. Removing and replacing the transducers

Removing a transducer

- Identify the missing ultrasonic path and failed transducers by using FHview (see p. **Erreur ! Signet non défini.Erreur ! Signet non défini.**).

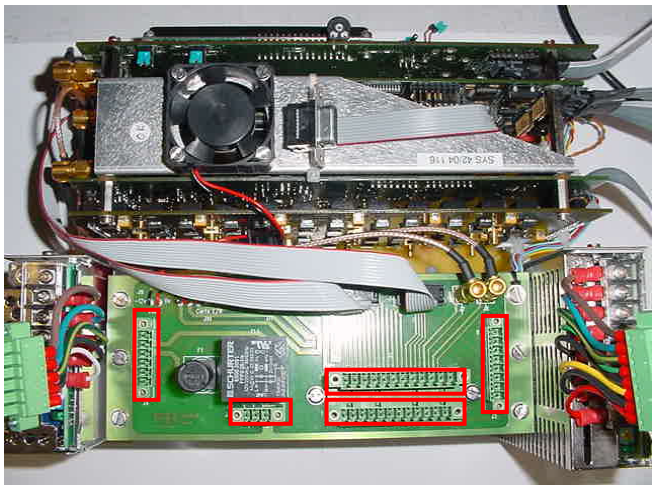
  > *Reminder: One path corresponds to two transducers.*

- Empty the line.
- **Turn off the power supply.**
- If necessary, unseal the converter's enclosure.
- Unscrew and remove the converter's cover.
- Unscrew and remove the cable cover.

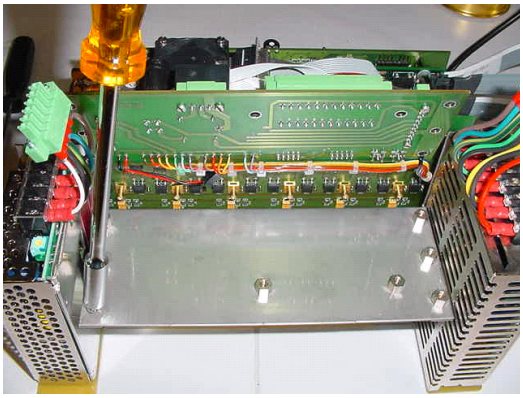


- Unscrew and remove both transducer protection casings.

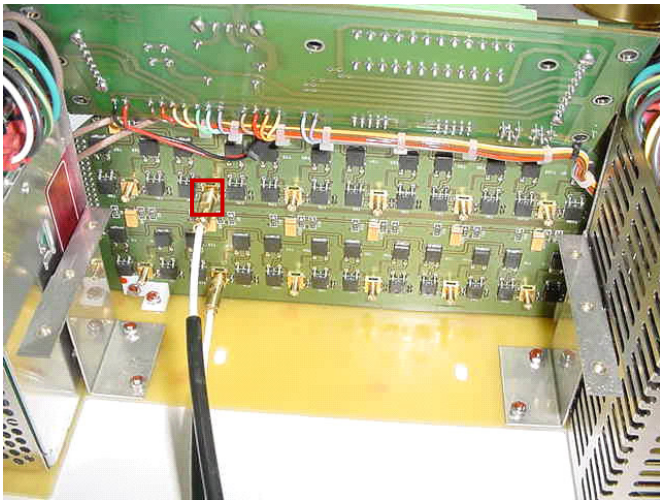
- Disconnect the 5 terminal strips, as shown, from the connecting board.



- Unscrew and remove the connecting board.
- Unscrew and remove the stainless steel plate.



- ❑ Disconnect carefully the concerned tranducer's cables.



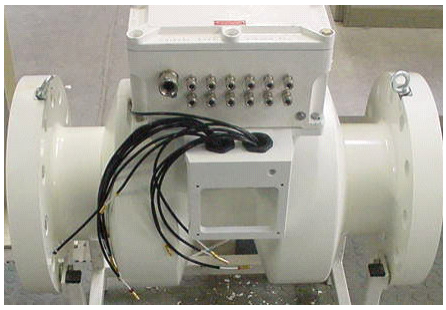
- ❑ Measure the transducers' capacitance.

  The value must be about 2.9 nF.

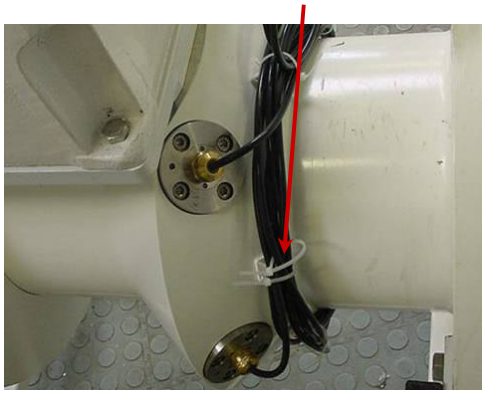
  - If the value is ≈ 2 nF, one active element is faulty.
  - If the value is ≈ 1 nF, 2 active elements are faulty.
  - If the value is ≈ 0 nF, all active elements are faulty.

  In all these cases, the transducer must be replaced.

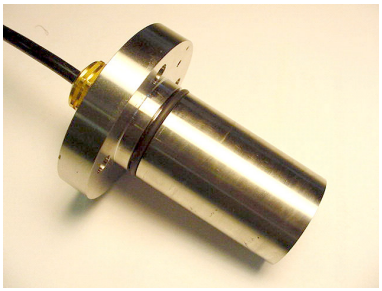
- ❑ Pull the cable out of the converter enclosure.



- Remove the transducers' cable fasteners.

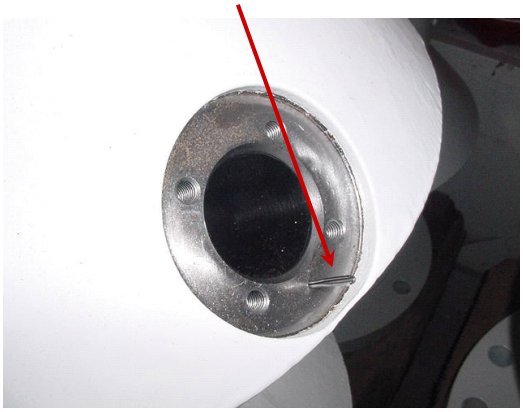


- Unscrew and remove the transducer carefully from its location by using the ref 204524ENC Faure Herman tools.



Installing a new transducer

- Take a new transducer and put a thin layer of multi-function grease on the housing.
- Place the new transducer in its location (a positioning pin avoids any misplacement).



- Connect the transducer's cable into the converter.
- Install and screw the stainless steel plate.
- Install and screw the connecting board.
- Connect terminal strips on the connecting board.
- Close the converter and screw the cover.
- Put the cable cover and transducers casing back in place.
- Turn the power supply on.
- Perform a zeroing according to the appropriate procedure (see next section).

Note: After transducers replacement, the FH 8500 flow meter does not require any re-calibration.

3. Performing a zeroing procedure

- Turn down the flow and keep the pipe at the working pressure or at a pressure greater than 3/4 bars.
- Shut off the closest upstream and downstream valves. The pressure shall stay at the value obtained in the previous step.
- Wait 10 to 15 minutes for the random velocities to become quiet.
- Perform the zeroing operation by using the remote control device (see p. 46).

Chapter 5:
Modbus transmission tables

Avalaible tables

The FH8500 comprises 8 data tables:

- **Table n° 1** (reference address 0h):

  Table containing the main measure data, in particular:
  - display units
  - units used for the 4-20 mA and the alarms
  - flow rate in m^3/s
  - temperature in °C
  - pressure in bar
  - volume in m^3
  - velocity of flow in m/s
  - average velocity of sound in m/s

- **Table n° 2** (reference address 100h)

  Table containing the alarm and working data of the FH8500, in particular
  - alarm counters
  - number of paths in operation
  - average value of the signal attenuation
  - working mode (custody, non custody, factory)
  - alarm settings

- **Table n° 3** (reference address 200h)

  Table containing the variables measured by the paths, in particular:
  - for each path: velocity of flow, velocity of sound, signal attenuation
  - volume in liters
  - average flow rate in m^3/s
  - average velocity of flow in m/s
  - average velocity of sound in m/s
  - average signal attenuation in dB

- **Table n° 4** (reference address 400h)

  Table containing the custody and calibration parameters, in particular
  - K-factor value and unit
  - filter time constant
  - inside diameter
  - calibration coefficients

- **Table n° 5** (reference address 500h)

  Table containing the non custody parameters, in particular:
  - setting of the 3 analog outputs
  - setting of the temperature and pressure inputs
  - date and time of the FH8500

- **Table n° 6** (reference address 600h)

  Table containing the release numbers of the FH8500 components

- **Table n° 7** (reference address 1000h)

  Table containing the Data logger data, in particular:
  - contents of the last record
  - number of the last record
  - number of the record to be read
  - Data logger period

- **Table n° 8** (reference address 1800h)

  Table containing the Event logger data, in particular:
  - contents of the last record
  - number of the last record
  - number of the record to be read

Main characteristics of the transmission

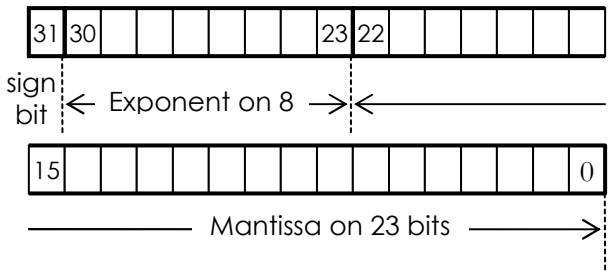
- Protocol used: Modbus RTU (8-bit binary transmission)
- Working mode of the FH8500 : slave
- Baud rate: 9 600 or 19 200 bauds
- Number of bits : 8
- Number of start bits: 1
- Number of stop bits : 1
- Parity : None
- Error check: CRC16

Transmission formats

A Modbus word is composed of two bytes.

Data are transmitted according to one the following formats:

- Integer (symbol INT) : 1 Modbus word, that is 2 bytes
- Long integer (symbol LINT) : 2 Modbus words, that is 4 bytes
- IEEE 32-bit floating number (symbol FLOAT) : 2 Modbus words, that is 4 bytes, constituted as follows



$$V = (-1)^S \left(1 + \frac{M}{2^{23}}\right) \cdot 2^{E-127}$$

Example: Given the value 40.21.80.40h

0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1
1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0

(S = 0, E = 128, M = 218040h = 2195520)

$$V = (-1)^0 \left(1 + \frac{2195520}{2^{23}}\right) \cdot 2^{128-127} = 2{,}523452759$$

Data are put in the tables starting with the most significant byte (MSB), except fot the CRC 16 control word which is transmitted beginning by the least significant byte.

The Modbus functions accepted by the FH8500 are the 3 (reading of n words) and the 16 (writing of n words) functions.

Framework for the reading of "n" Modbus words (1 ≤ n ≤ 125)

Request

Slave number	Function code (3)	Address of the 1st word	Number of words (n)	CRC16 Control
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Response

Slave number	Function code (3)	Number of read bytes	Value of the 1st word		Value of the last word	CRC16 Control
1 byte	1 byte	1 byte	2 bytes		2 bytes	2 bytes

Framework for the writing of n Modbus words (1≤ n ≤ 123)

Request

Slave number	Function code (16)	Address of the 1st word	Number of words (n)	Nb of bytes in demand	Value of the 1st word		Value of the last word	CRC16 control
1 byte	1 byte	2 bytes	2 bytes	1 byte	2 bytes		2 bytes	2 bytes

Response

Slave number	Function code (16)	Address of the 1st word	Number of words (n)	CRC16 control
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Structure of the table n°1

Reference address 000h; main measure data

	Modbus address	Name and description	Format	Access	
				CM	NCM
Dsiplayed values	000h	DISPLAYED FLOW RATE Gross flow expressed in the unit selected for the display (see 040h)	FLOAT	R	R
	002h	DISPLAYED VELOCITY OF FLUID Fluid velocity expressed in the unit selected for the display (see 041h)	FLOAT	R	R
	004h	DISPLAYED VELOCITY OF SOUND Sound velocity expressed in the unit selected for the display (see 042h)	FLOAT	R	R
	006h	DISPLAYED TEMPERATURE Temperature expressed in the unit selected for the display (see 043h) *Remark : 0 if temperature sensor not wired*	FLOAT	R	R
	008h	DISPLAYED PRESSURE Pressure expressed in the unit selected for the display (see 044h) *Remark : 0 if pressure sensor not wired*	FLOAT	R	R
	00Ah	DISPLAYED TOTALIZER Totalizer expressed in the unit selected for the display (see 045h)	FLOAT	R	R

Units for the 4-20 mA outputs and alarms

Modbus address	Name and description	Format	Access	
			CM	NCM
00Ch	FLOW RATE UNIT Unit used for the gross flow (4-20 mA and alarms) 1 m^3/h 2 m^3/mn 3 m^3/s 4 l/h 5 l/mn 6 l/s 7 gpm 8 bph	INT	R/W	R/W
00Dh	VELOCITY OF FLUID UNIT Unit used for the velocity of fluid (4-20 mA and alarms) 1 m/s 2 ft/s	INT	R/W	R/W
00Eh	VELOCITY OF SOUND UNIT Unit used for the velocity of sound (4-20 mA and alarms) 1 m/s 2 ft/s	INT	R/W	R/W
00Fh	TEMPERATURE UNIT Unit used for the temperature (4-20 mA and alarms) 1 °C 2 °F 3 K	INT	R/W	R/W

	Modbus address	Name and description	Format	Access	
				CM	NCM
Units for 4-20 mA and alarms (followed)	010h	PRESSURE UNIT Unit used for the pressure (4-20 mA and alarms) 1 bar 2 kPa 3 psi	INT	R/W	R/W
	011h	TOTALIZER UNIT Unit used for the totalizer (4-20 mA and alarms) 1 m^3 2 l 3 gal 4 bbl	INT	R/W	R/W
Values expressed in SI units	012h	FLOW RATE IN S.I. UNIT Flow rate expressed in m^3/s	FLOAT	R	R
	014h	TEMPERATURE IN S.I. UNIT Temperature expressed in °C	FLOAT	R	R
	016h	PRESSURE IN S.I. UNIT Pressure expressed in bar	FLOAT	R	R
	018h	TOTALIZER IN S.I. UNIT Totalizer expressed in m^3	FLOAT	R	R
	01Ah to 021h	Words not used	FLOAT	R	R
	022h	VELOCITY OF SOUD IN S.I. UNIT Velocity of sound expressed in m/s	FLOAT	R	R
	024h	VELOCITY OF FLUID IN S.I. UNIT Velocity of fluid expressed in m/s	FLOAT	R	R
	026h to 03Fh	Words not used			

	Modbus address	Name and description	Format	Access	
				CM	NCM
Display units	040h	FLOW RATE DISPLAY UNIT Unit used for the display of the flow rate (see 00Ch for the list of units)	INT	R/W	R/W
	041hh	VELOCITY OF FLUID DISPLAY UNIT Unit used for the display of the velocity of fluid (see 00Dh for the list of units)	INT	R/W	R/W
	042h	VELOCITY OF SOUND DISPLAY UNIT Unit used for the display of the velocity of sound (see 00Eh for the list of units)	INT	R/W	R/W
	043h	TEMPERATURE DISPLAY UNIT Unit used for the display of the temperature (see 00Fh for the list of units)	INT	R/W	R/W
	044h	PRESSURE DISPLAY UNIT Unit used for the display of the pressure (see 010h for the list of units)	INT	R/W	R/W
	045h	TOTALIZER DISPLAY UNIT Unit used for the display of the totalizer (see 011h for the list of units)	INT	R/W	R/W
Reset of the totalizer	046h	TOTALIZER RESET Write a 1 value in this word to demand the reset of the totalizer *Remark: This word is reset to 0 when the totalizer reset is over.*	INT	R/W	R/W

Structure of the table n° 2

Reference address 100h; alarm and operation data

	Modbus address	Name and description	Format	Access	
				CM	NCM
Alarm counters	100h	ALARM 1 COUNTER Counter of occurrences of alarm 1	INT	R	R
Alarm counters	101h	ALARM 2 COUNTER Counter of occurrences of alarm 2	INT	R	R
Validity of measure	102h	VALID BEAMS Number of valid beams	INT	R	R
Validity of measure	103h	SIGNAL Average attenuation of the ultrasonic signals, in dB	FLOAT	R	R
Working mode	105h	CUSTODY / NON CUSTODY FH8500 working mode 00h | custody mode FFh | non custody mode	INT	R	R
Reset alarms	106h	ALARM CLEAR Reset of both alarm counters (write a 0 value for resetting)	INT	W	W
	107h	Word reserved for internal use			

	Modbus address	Name and description	Format	Access	
				CM	NCM
Definition of the alarm 1	108h	ALARM 1 VARIABLE Variable assigned to the alarm 1 1 Velocity of sound 2 Velocity of fluid 3 Flow rate 4 Volume 5 Pressure 6 Temperature 7 Gain 8 Number of valid paths	INT	R/W	R/W
	109h	ALARM 1 LIMIT Type of comparison with the alarm 1 threshold 1 >|2 <	INT	R/W	R/W
	10Ah	ALARM 1 THRESHOLD Value of the alarm 1 threshold	FLOAT	R/W	R:W
	10Ch	ALARM 1 UNIT Unit assigned to the alarm 1 threshold	INT	R	R:W
Definition of the alarm 2	10Dh	ALARM 2 VARIABLE Variable assigned to the alarm 2 (see 108h for the list of variables)	INT	R/W	R:W
	10Eh	ALARM 2 LIMIT Type of comparison with the alarm 2 threshold (see 109h)	INT	R/W	R:W
	10Fh	ALARM 2 THRESHOLD Value of the alarm 2 threshold	FLOAT	R/W	R:W
	111h	ALARM 2 UNIT Unit assigned to the alarm 2 threshold idem 10Ch	INT	R	R:W

Alarm thresholds in S.I. units

Modbus address	Name and description	Format	Access	
			CM	NCM
112h	ALARM 1 THRESHOLD IN S.I. UNIT Value of the alarm 1 threshold expressed in the SI unit of the variable assigned to the alarm 1 (for example, m^3/s if the variable assigned to the alarm 1 is the flow rate)	FLOAT	R	R
114h	ALARM 2 THRESHOLD IN S.I. UNIT Value of the alarm 2 threshold expressed in the SI unit of the variable assigned to the alarm 2	FLOAT	R	R

Structure of the table n° 3

Reference address 200h; data measured by paths

	Modbus address	Name and description	Format	Access	
				CM	NCM
Values calculated by the path 1	200h	BEAM01 VELOCITY Velocity of fluid, in m/s, computed by the path 1 *Remark : The value is equal to 0 if the path is not valid.*	FLOAT	R	R
	202h	BEAM01 VOS Velocity of sound, in m/s, computed by the path 1 *Remark : The value is equal to 0 if the path is not valid.*	FLOAT	R	R
	204h	BEAM01 SIGNAL Attenuation, in dB, computed by the path 1	FLOAT	R	R
	206h	BEAM01 BIAS_STAT Correction brought to the path 1	FLOAT	R	R
	208h to 20Fh	Words not used			
Values calculated by the paths 2 to 6	210h to 217h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 2	FLOAT	R	R
	218h to 21Fh	Words not used			
	220h to 227h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 3	FLOAT	R	R
	228h to 22Fh	Words not used			
	230h to 237h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 4	FLOAT	R	R
	238h to 23Fh	Words not used			
	240h to 247h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 5	FLOAT	R	R
	248h to 24Fh	Words not used			
	250h to 257h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 6	FLOAT	R	R
	258h to 25Fh	Words not used			

Values calculated by the paths 7 to 15

Modbus address	Name and description	Format	Access	
			CM	NCM
260h to 267h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 7	FLOAT	R	R
268h to 26Fh	Words not used			
270h to 277h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 8	FLOAT	R	R
278h to 27Fh	Words not used			
280h to 287h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 9	FLOAT	R	R
288h to 28Fh	Words not used			
290h to 297h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 10	FLOAT	R	R
298h to 29Fh	Words not used			
2A0h to 2A7h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 11	FLOAT	R	R
2A8h to 2AFh	Words not used			
2B0h to 2B7h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 12	FLOAT	R	R
2B8h to 2BFh	Words not used			
2C0h to 2C7h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 13	FLOAT	R	R
2C8h to 2CFh	Words not used			
2D0h to 2D7h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 14	FLOAT	R	R
2D8h to 2DFh	Words not used			
2E0h to 2E7h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 15	FLOAT	R	R
2E8h to 2EFh	Words not used			

	Modbus address	Name and description	Format	Access	
				CM	NCM
Values calculated by the paths 16 to 18	2F0h to 2F7h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 16	FLOAT	R	R
	2F8h to 2FFh	Words not used			
	300h to 307h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 17	FLOAT	R	R
	308h to 30Fh	Words not used			
	310h to 317h	Velocity of fluid, velocity of sound, signal attenuation and correction of the path 18	FLOAT	R	R
	318h	CORRECTED DIAMETER	FLOAT	R	R
	31Ah to 31Fh	Words not used			
Processing of the zeroing	32Ah	ZEROING PROCESSING Processing of the FH8500 zeroing (0 to 100%)	LONG	R	R

Structure of the table n° 4

Reference address 400h; custody and calibration parameters

	Modbus address	Name and description	Format	Access	
				CM	NCM
Definition of K-factor	400h	K-FACTOR VALUE K-factor value expressed in the unit stored in 402h	FLOAT	R	R/W
Definition of K-factor	402h	K-FACTOR UNIT K-factor unit 1 | pulses / m^3 2 | pulses / l 3 | pulses / gallon 4 | pulses / barrel	LONG	R	R/W
Tuning values	404h	INSIDE DIAMETER Flowmeter inside diameter	FLOAT	R	R/W
Tuning values	406h	TOTALIZER VALUE BEFORE POWER OFF Value of the totalizer before the last power off	FLOAT	R	R/W
Tuning values	408h and 409h	THERMAL EXPANSION FACTOR Expansion factor of the body in $m.m^{-1}.°C^{-1}.10^{-6}$	FLOAT	R	R/W
Tuning values	40Ah	DAMPING Filter time constant	FLOAT	R	R/W
Tuning values	40Ch	COEF 1 Calibration coefficient 1	FLOAT	R	R/W
Tuning values	40Eh	COEF 2 Calibration coefficient 2	FLOAT	R	R/W
Tuning values	410h	COEF 3 Calibration coefficient 3	FLOAT	R	R/W
Tuning values	412h	COEF 4 Calibration coefficient 4	FLOAT	R	R/W

Tuning values (followed)

Modbus address	Name and description	Format	Access	
			CM	NCM
414h	COEF 5 — Calibration coefficient 5	FLOAT	R	R/W
416h	COEF 6 — Calibration coefficient 6	FLOAT	R	R/W
418h	COEF 7 — Calibration coefficient 7	FLOAT	R	R/W
41Ah	COEF 8 — Calibration coefficient 8	FLOAT	R	R/W
41Ch	COEF 9 — Calibration coefficient 9	FLOAT	R	R/W
41Eh	COEF 10 — Calibration coefficient 10	FLOAT	R	R/W
420h	K FACTOR IN S.I. UNIT — K-factor expressed in pulses / m^3	FLOAT	R	R

Structure of the table n° 5

Reference address 500h; non custody parameters

	Modbus address	Name and description	Format	Access	
				CM	NCM
Setting of the analog output n° 1	500h	OUTPUT 4/20 mA N° 1 UNIT Depending on the variable assigned to the analog output n° 1, unit used by the output (see words 00Ch to 011h of the table 1)	INT	R	R
	501h	OUTPUT 4/20 mA N° 1 : 4 mA VALUE Scale limit assigned to the 4 mA value of the analog output n° 1, in the unit stored in 500h	FLOAT	R/W	R/W
	503h	OUTPUT 4/20 mA N° 1 : 20 mA VALUE Scale limit assigned to the 20 mA value of the analog output n° 1, in the unit stored in 500h	FLOAT	R/W	R/W
	505h	OUTPUT 4/20 mA N° 1 : TYPE Variable assigned to the analog output n° 1 1 Velocity of sound 2 Velocity of fluid 3 Flowrate 4 Volume 5 Pressure 6 Temperature 7 Gain	INT	R/W	R/W
	506h to 508h	Words not used			
Setting of the temperature	509h	INPUT TEMPERATURE : 4 mA VALUE Scale limit assigned to the 4 mA value of the temperature input, expressed in the unit defined in table 1's 00Fh word	FLOAT	R/W	R/W
	50Bh	INPUT TEMPERATURE : 20 mA VALUE Scale limit assigned to the 20 mA value of the temperature input, expressed in the unit defined in table 1's 00Fh word	FLOAT	R/W	R/W

	Modbus address	Name and description	Format	Access	
				CM	NCM
Setting of the pressure	50Dh	INPUT PRESSURE : 4 mA VALUE Scale limit assigned to the 4 mA value of the pressure input, expressed in the unit defined in table 1's 010h word	FLOAT	R/W	R/W
	50Fh	INPUT PRESSURE : 20 mA VALUE Scale limit assigned to the 20 mA value of the pressure input, expressed in the unit defined in table 1's 010h word	FLOAT	R/W	R/W
Date and time of the FH8500	511h	YEAR	INT	R/W	R/W
	512h	MONTH	INT	R/W	R/W
	513h	DAY	INT	R/W	R/W
	514h	HOUR	INT	R/W	R/W
	515h	MINUTE	INT	R/W	R/W
	516h	SECOND	INT	R/W	R/W
	517h	Word not used			
Calibration of temperature and pressure inputs	518h	INPUT TEMPERATURE : 4 mA VALUE CALIBRATION Calibration value for the 4 mA limit of temperature input (only in factory mode)	FLOAT	R	R
	51Ah	INPUT TEMPERATURE : 20 mA VALUE CALIBRATION Calibration value for the 20 mA limit of temperature input (only in factory mode)	FLOAT	R	R
	51Ch	INPUT PRESSURE : 4 mA VALUE CALIBRATION Calibration value for the 4 mA limit of pressure input (only in factory mode)	FLOAT	R	R
	51Eh	INPUT PRESSURE : 20 mA VALUE CALIBRATION Calibration value for the 20 mA limit of pressure input (only in factory mode)	FLOAT	R	R

	Modbus address	Name and description	Format	Access	
				CM	NCM
Scale limits 4 and 20 mA in S.I. units	520h	OUTPUT 4/20 mA N° 1 : 4 mA IN S.I. UNIT Scale limit assigned to the 4 mA value of the analog output n° 1, in the SI unit corresponding to the variable assigned to the output	FLOAT	R	R
	522h	OUTPUT 4/20 mA N° 1 : 20 mA IN S.I. UNIT Scale limit assigned to the 20 mA value of the analog output n° 1, in the SI unit corresponding to the variable assigned to the output	FLOAT	R	R
	524h	Word not used			
	525h	INPUT TEMPERATURE : 4 mA IN S.I. UNIT Scale limit assigned to the 4 mA value of the temperature input, in °C	FLOAT	R	R
	527h	INPUT TEMPERATURE : 20 mA IN S.I. UNIT Scale limit assigned to the 20 mA value of the temperature input, in °C	FLOAT	R	R
	529h	INPUT PRESSURE : 4 mA IN S.I. UNIT Scale limit assigned to the 4 mA value of the pressure input, in bar	FLOAT	R	R
	52Bh	INPUT PRESSURE : 20 mA IN S.I. UNIT Scale limit assigned to the 20 mA value of the pressure input, in bar	FLOAT	R	R
	52Dh to 538h	Words not used			
Calibration of the analog output n° 1	539h	OUTPUT 4/20 mA N° 1 : 4 mA VALUE CALIBRATION Calibration value for the 4 mA limit of of output n° 1 (only in factory mode)	FLOAT		
	53Bh	OUTPUT 4/20 mA N° 1 : 20 mA VALUE CALIBRATION Calibration value for the 20 mA limit of output n° 1 (only in factory mode)	FLOAT		
	53Dh to 54Fh	Words not used			

	Modbus address	Name and description	Format	Access	
				CM	NCM
Setting of the analog output n° 2	550h	OUTPUT 4/20 mA N° 2 UNIT Depending on the variable assigned to the analog output n° 2, unit used by the output (see words 00Ch to 011h of the table 1)	INT	R	R
	551h	OUTPUT 4/20 mA N° 2 : 4 mA VALUE Scale limit assigned to the 4 mA value of the analog output n° 2, in the unit stored in 550h	FLOAT	R/W	R/W
	553h	OUTPUT 4/20 mA N° 2 : 20 mA VALUE Scale limit assigned to the 20 mA value of the analog output n° 2, in the unit stored in 550h	FLOAT	R/W	R/W
	555h	OUTPUT 4/20 mA N° 2 : TYPE Variable assigned to the analog output n° 2 (see 505h)	INT	R/W	R/W
4-20 mA scale limits for the analog output n° 2 in S.I units	556h	OUTPUT 4/20 mA N° 2 : 4 mA IN S.I. UNIT Scale limit assigned to the 4 mA value of the analog output n° 2, in the SI unit corresponding to the variable assigned to the output	FLOAT	R	R
	558h	OUTPUT 4/20 mA N° 2 : 20 mA IN S.I. UNIT Scale limit assigned to the 20 mA value of the analog output n° 2, in the SI unit corresponding to the variable assigned to the output	FLOAT	R	R
	55Ah to 55Eh	Words not used			
Calibration of the analog output n° 2	55Fh	OUTPUT 4/20 mA N° 2 : 4 mA VALUE CALIBRATION Calibration value for the 4 mA limit of output n° 2 (only in factory mode)	FLOAT		
	561h	OUTPUT 4/20 mA N° 2 : 20 mA VALUE CALIBRATION Calibration value for the 20 mA limit of output n° 2 (only in factory mode)	FLOAT		
	563h to 56Fh	Words not used			

	Modbus address	Name and description	Format	Access	
				CM	NCM
Setting of the analog output n° 3	570h	OUTPUT 4/20 mA N° 3 UNIT Depending on the variable assigned to the analog output n° 3, unit used by the output (see words 00Ch to 011h of the table 1)	INT	R	R
	571h	OUTPUT 4/20 mA N° 3 : 4 mA VALUE Scale limit assigned to the 4 mA value of the analog output n° 3, in the unit stored in 570h	FLOAT	R/W	R/W
	573h	OUTPUT 4/20 mA N° 3 : 20 mA VALUE Scale limit assigned to the 20 mA value of the analog output n° 3, in the unit stored in 570h	FLOAT	R/W	R/W
	575h	OUTPUT 4/20 mA N° 3 : TYPE Variable assigned to the analog output n° 3 (see 505h)	INT	R/W	R/W
4 - 20 mA limits for the An. O. n° 3 in S.I. units	576h	OUTPUT 4/20 mA N° 3 : 4 mA IN S.I. UNIT Scale limit assigned to the 4 mA value of the analog output n° 3, in the SI unit corresponding to the variable assigned to the output	FLOAT	R	R
	578h	OUTPUT 4/20 mA N° 3 : 20 mA IN S.I. UNIT Scale limit assigned to the 20 mA value of the analog output n° 3, in the SI unit corresponding to the variable assigned to the output	FLOAT	R	R
	580h to 57Eh	Words not used			
Calibration of the analog output n° 3	57Fh	OUTPUT 4/20 mA N° 3 : 4 mA VALUE CALIBRATION Calibration value for the 4 mA limit of output n° 3 (only in factory mode)	FLOAT		
	581h	OUTPUT 4/20 mA N° 3 : 20 mA VALUE CALIBRATION Calibration value for the 20 mA limit of output n° 3 (only in factory mode)	FLOAT		

Structure of the table n° 6

Reference address 600h; version of the components

The version number and the release dates are expressed in ASCII by means of 64 character chains (32 Modbus containing each two characters) ended by CR LF \0.
Example : V 2.0 17/11/2002 \n.

Modbus address	Name and description	Format	Access	
			CM	NCM
600h	METER TYPE Type of the meter (example : FH8500-0)	32*INT	R	R
620h	METER S/N	32*INT	R	R
640h	INTERFACE BOARD CPU	32*INT	R	R
660h	INTERFACE BOARD CPLD	32*INT	R	R
680h	TR BOARD CPLD	32*INT	R	R
6A0h	PROCESS BOARD DSP	32*INT	R	R

Structure of the table n° 7

Reference address 1000h; consultation of the data logger

Modbus address	Name and description	Format	Access	
			CM	NCM
1000h to 10FFh	DATA LOGGER RECORD Data logger record corresponding to the number given in 1101h (see table 7-1)			
1100h	MOST RECENT RECORD NUMBER Number of the last record performed by FH8500	INT	R	R
1101h	RECORD NUMBER Number of the transmitted record or number of the record to be read	INT	R/W	R/W
1102h	DATA LOGGER PERIOD Recording period of the data logger 1 : 1 s 2 : 5 s 3 : 10 s 4 : 30 s 5 : 1 mn 6 : 2 mn 7 : 5 mn 8 : 10 mn 9 : 15 mn 10 : 30 mn 11 : 1 h 12 : 2 h 13 : 6 h 14 : 12 h 15 : 24 h	INT	R/W	R/W
1103h	DATA LOGGER CLEAR Reset of the data logger by writing a 0 value	INT	W	W

Structure of a Data logger record

Modbus address	Name and description	Format	Access	
			CM	NCM
1000h	FLOW RATE Gross flowrate, in m^3/s	FLOAT	R	R
1002h	VELOCITY OF FLUID Velocity of fluid, in m/s	FLOAT	R	R
1004h	VELOCITY OF SOUND Velocity of sound, in m/s	FLOAT	R	R
1006h	METER TEMPERATURE Temperature, in °C	FLOAT	R	R
1008h	METER PRESSURE Pressure in bar	FLOAT	R	R
100Ah	SIGNAL Average signal, in dB	FLOAT	R	R
100Ch	FLUID VELOCITY ON BEAM 1 Fluid velocity on beam 1, in m/s	FLOAT	R	R
100Eh	FLUID VELOCITY ON BEAM 2	FLOAT	R	R
1010h	FLUID VELOCITY ON BEAM 3	FLOAT	R	R
1012h	FLUID VELOCITY ON BEAM 4	FLOAT	R	R
1014h	FLUID VELOCITY ON BEAM 5	FLOAT	R	R
1016h	FLUID VELOCITY ON BEAM 6	FLOAT	R	R
1018h	FLUID VELOCITY ON BEAM 7	FLOAT	R	R
101Ah	FLUID VELOCITY ON BEAM 8	FLOAT	R	R
101Ch	FLUID VELOCITY ON BEAM 9	FLOAT	R	R
101Eh	FLUID VELOCITY ON BEAM 10	FLOAT	R	R
1020h	FLUID VELOCITY ON BEAM 11	FLOAT	R	R
1022h	FLUID VELOCITY ON BEAM 12	FLOAT	R	R
1024h	FLUID VELOCITY ON BEAM 13	FLOAT	R	R
1026h	FLUID VELOCITY ON BEAM 14	FLOAT	R	R

Modbus address	Name and description	Format	Access	
			CM	NCM
1028h	FLUID VELOCITY ON BEAM 15	FLOAT	R	R
102Ah	FLUID VELOCITY ON BEAM 16	FLOAT	R	R
102Ch	FLUID VELOCITY ON BEAM 17	FLOAT	R	R
102Eh	FLUID VELOCITY ON BEAM 18	FLOAT	R	R
1030h	VELOCITY OF SOUND ON BEAM 1 Velocity of sound on beam 1, in m/s	FLOAT	R	R
1032h	VELOCITY OF SOUND ON BEAM 2	FLOAT	R	R
1034h	VELOCITY OF SOUND ON BEAM 3	FLOAT	R	R
1036h	VELOCITY OF SOUND ON BEAM 4	FLOAT	R	R
1038h	VELOCITY OF SOUND ON BEAM 5	FLOAT	R	R
103Ah	VELOCITY OF SOUND ON BEAM 6	FLOAT	R	R
103Ch	VELOCITY OF SOUND ON BEAM 7	FLOAT	R	R
103Eh	VELOCITY OF SOUND ON BEAM 8	FLOAT	R	R
1040h	VELOCITY OF SOUND ON BEAM 9	FLOAT	R	R
1042h	VELOCITY OF SOUND ON BEAM 10	FLOAT	R	R
1044h	VELOCITY OF SOUND ON BEAM 11	FLOAT	R	R
1046h	VELOCITY OF SOUND ON BEAM 12	FLOAT	R	R
1048h	VELOCITY OF SOUND ON BEAM 13	FLOAT	R	R
104Ah	VELOCITY OF SOUND ON BEAM 14	FLOAT	R	R
104Ch	VELOCITY OF SOUND ON BEAM 15	FLOAT	R	R
104Eh	VELOCITY OF SOUND ON BEAM 16	FLOAT	R	R
1050h	VELOCITY OF SOUND ON BEAM 17	FLOAT	R	R
1052h	VELOCITY OF SOUND ON BEAM 18	FLOAT	R	R
1054h	SIGNAL ON BEAM 1 Signal attenuation on beam 1, in dB	FLOAT	R	R
1056h	SIGNAL ON BEAM 2	FLOAT	R	R
1058h	SIGNAL ON BEAM 3	FLOAT	R	R
105Ah	SIGNAL ON BEAM 4	FLOAT	R	R
105Ch	SIGNAL ON BEAM 5	FLOAT	R	R
105Eh	SIGNAL ON BEAM 6	FLOAT	R	R

Modbus address	Name and description	Format	Access	
			CM	NCM
1060h	SIGNAL ON BEAM 7		R	R
1062h	SIGNAL ON BEAM 8		R	R
1064h	SIGNAL ON BEAM 9		R	R
1066h	SIGNAL ON BEAM 10		R	R
1068h	SIGNAL ON BEAM 11		R	R
106Ah	SIGNAL ON BEAM 12		R	R
106Ch	SIGNAL ON BEAM 13		R	R
106Eh	SIGNAL ON BEAM 14		R	R
1070h	SIGNAL ON BEAM 15		R	R
1072h	SIGNAL ON BEAM 16		R	R
1074h	SIGNAL ON BEAM 17		R	R
1076h	SIGNAL ON BEAM 18		R	R
1078h to 10FFh	WORDS NOT USED		R	R

Structure of the table n° 8

Reference address 1800h; consultation of the Event logger

Modbus address	Name and description	Format	Access	
			CM	NCM
1800h to 1807h	EVENT LOGGER RECORD Event logger record corresponding to the number given in 1809h (see structure on page 85)			
1808h	MOST RECENT RECORD NUMBER Number of the last record performed by FH8500	INT	R	R
1809h	RECORD NUMBER Number of the transmitted record or number of the records to be read	INT	R/W	R/W
180A	EVENT LOGGER CLEAR Reset of the event logger by writing a 0 value	INT	W	W

Structure of an Event logger record

<table>
<tr><th>Modbus address</th><th>Name and description</th><th>Format</th><th colspan="2">Access</th></tr>
<tr><th></th><th></th><th></th><th>CM</th><th>NCM</th></tr>
<tr><td>1800h</td><td>RECORD NUMBER
Number of the current record</td><td>INT</td><td>R</td><td>R</td></tr>
<tr><td>1801h</td><td>STATUS REGISTER
4-byte status register :
<table><tr><th>bit</th><th></th></tr><tr><td>0</td><td>Power on</td></tr><tr><td>1</td><td>Power off</td></tr><tr><td>2</td><td>Alarm 1 on</td></tr><tr><td>3</td><td>Alarm 1 off</td></tr><tr><td>4</td><td>Alarm2 on</td></tr><tr><td>5</td><td>Alarm2 off</td></tr><tr><td>6 and 7</td><td>Operating mode
(00 : non custody mode ;
01 : custody mode ;
10 : factory mode)</td></tr><tr><td>8</td><td>Flow rate on</td></tr><tr><td>9</td><td>Flow rate off (VOF = 0 for all the 18 beams)</td></tr><tr><td>10</td><td>Oil presence</td></tr><tr><td>11</td><td>Oil absence (VOF = 0 and VOS = 0 for all the 18 beams)</td></tr><tr><td>12 to 31</td><td>bits not used</td></tr></table></td><td>LINT</td><td>R</td><td>R</td></tr>
<tr><td>1803h</td><td>YEAR</td><td>INT</td><td>R</td><td>R</td></tr>
<tr><td>1804h</td><td>DAY</td><td>INT</td><td>R</td><td>R</td></tr>
<tr><td>1805h</td><td>HOUR</td><td>INT</td><td>R</td><td>R</td></tr>
<tr><td>1806h</td><td>MINUTE</td><td>INT</td><td>W</td><td>W</td></tr>
<tr><td>1807h</td><td>SECOND</td><td>INT</td><td>W</td><td>W</td></tr>
</table>

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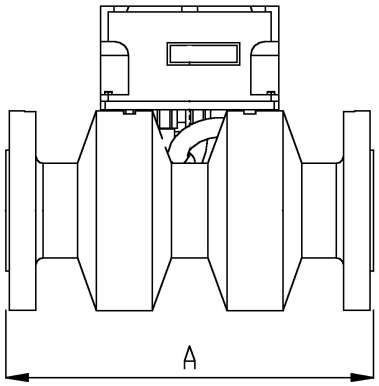
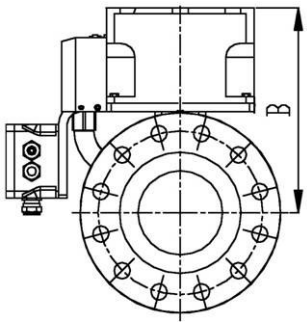
Appendix I

Dimensions, weight, maximal flow rate vs meter size





Diameter		**A** (approx.)		**B** (approx.)		**Min flow rate (1 m/s)**		**Max flow rate (15 m/s)**		**Weight** (approx.)	
inches	**DN**	**in.**	**cm**	**in.**	**cm**	**m^3/h**	**Bbl/h**	**m^3/h**	**Bbl/h**	**kg**	**lbs**
4	100	23	58	13.8	35	27	170	405	2,550	125	275
6	150	26	66	14.4	36	60	380	900	5,660	150	330
8	200	30	76	14.4	36	110	690	1,650	10,380	180	396
10	250	32	81	14.6	37	170	1,070	2,550	16,040	215	473
12	300	35	89	15.6	39	240	1,510	3,600	22,640	270	594
14	350	37	94	17.3	44	290	1,820	4,350	27,360	400	880
16	400	40	102	19.1	48	380	2,390	5,700	35,850	550	1,210
18	450	43	109	19.3	49	480	3,020	7,200	45,290	750	1,430
20	500	46	117	20.9	53	600	3,770	9,000	56,610	900	1,790
24	600	52	132	26.2	66	850	5,350	12,750	80,200	1,200	2,640

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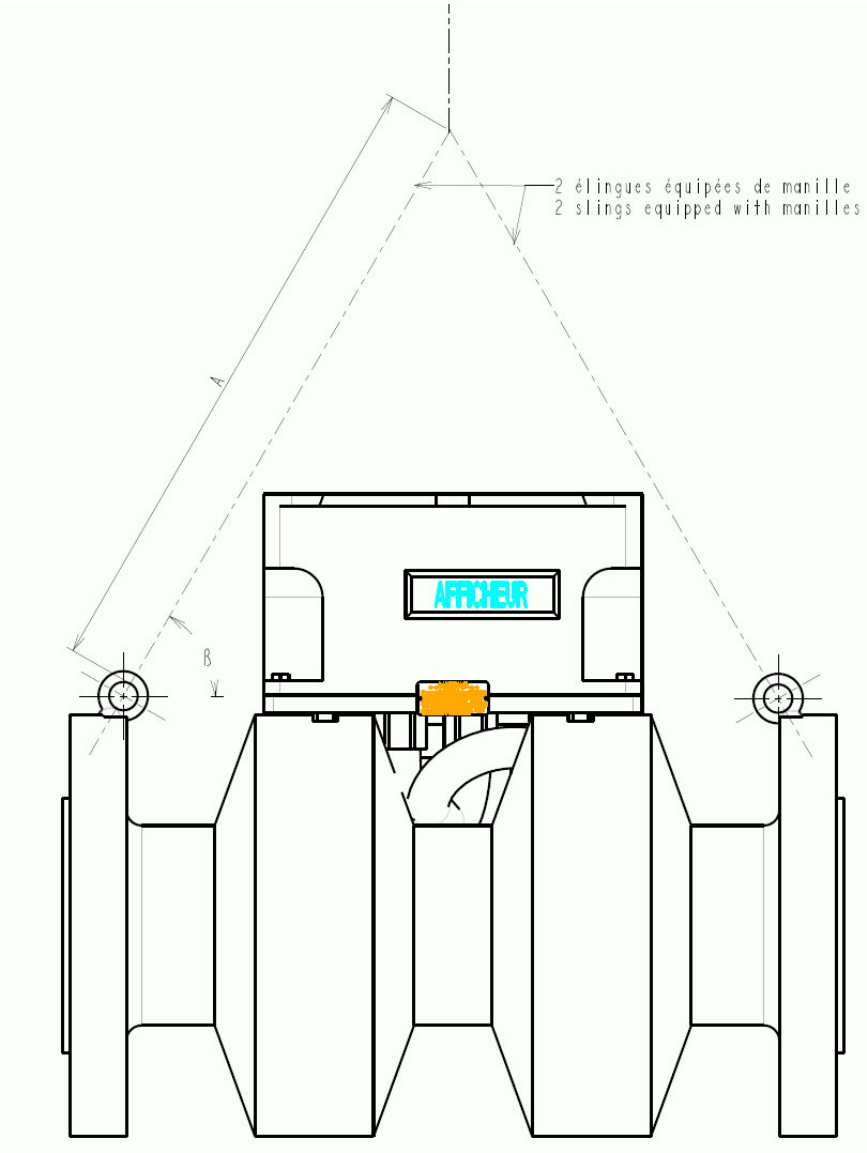
Appendix II

Lifting Arrangement Drawing



Lifting Arrangement Drawing

Diameter		L		β	Lifting ring AF42C2	Weight in # 600	Minimum nominal value of weight by sling lifting
Inches	mm	Inches (± 2)	Mm (± 50)				
4	100	26	650	65°	#150 M8 #300 #600 M10	155 Kg	120 Kg
6	150	22	550	60°	#150 M8 #300 #600 M10	200 Kg	150 Kg
8	200	25	630	60°	M10	255 Kg	200 Kg
10	250	27	670	60°	M10	345 Kg	260 Kg
12	300	30	740	60°	M10	415 Kg	320 Kg
14	350	35	880	60°	M14	600 Kg	450 Kg
16	400	37	930	60°	M14	760 Kg	570 Kg
18	450	38	960	60°	M14	900 Kg	680 Kg
20	500	39	980	60°	M20	1100 Kg	830 Kg
24	600	44	1100	60°	M20	1510 Kg	1150 Kg

Appendix III

FH8X00 HART Commands list

Unniversal Commands

Command 0	Read unique identifer
Command 1	Read primary variable
Command 2	Read loop current and percent of range
Command 3	Read dynamic variables and loopd current
Command 6	Write polling address
Command 7	Read loop configuration
Command 8	Read dynamic variable classifications
Command 9	Read device variables with status
Command 11	Read unique identifier associated with tag
Command 12	Read message
Command 13	Read tag, descriptor, date
Command 14	Read primary variable transducer information
Command 15	Read device information
Command 16	Read final assembly number
Command 17	Write message
Command 18	Write tag, descriptor, date
Command 19	Write final assembly number
Command 20	Read long tag
Command 21	Read unique identifier associated with long tag
Command 22	Write long tag

Transmitter Specific Commands

Command 140	Read variables produced
Command 141	Read units of variables produced
Command 142	Write units of variables produced
Command 143	Read custody configuration
Command 145	Read inputs/outputs configuration
Command 146	Write inputs/outputs configuration
Command 147	Read alarms configuration
Command 148	Write alarms configuration
Command 151	Read versions n°1
Command 152	Read meter type
Command 153	Read versions n°2
Command 154	Read units of alarms & inputs/outputs
Command 155	Write units of alarms & inputs/outputs
Command 157	Read measures on beams 1 to 3
Command 158	Read measures on beams 4 to 9
Command 159	Read measures on beams 10 to 18

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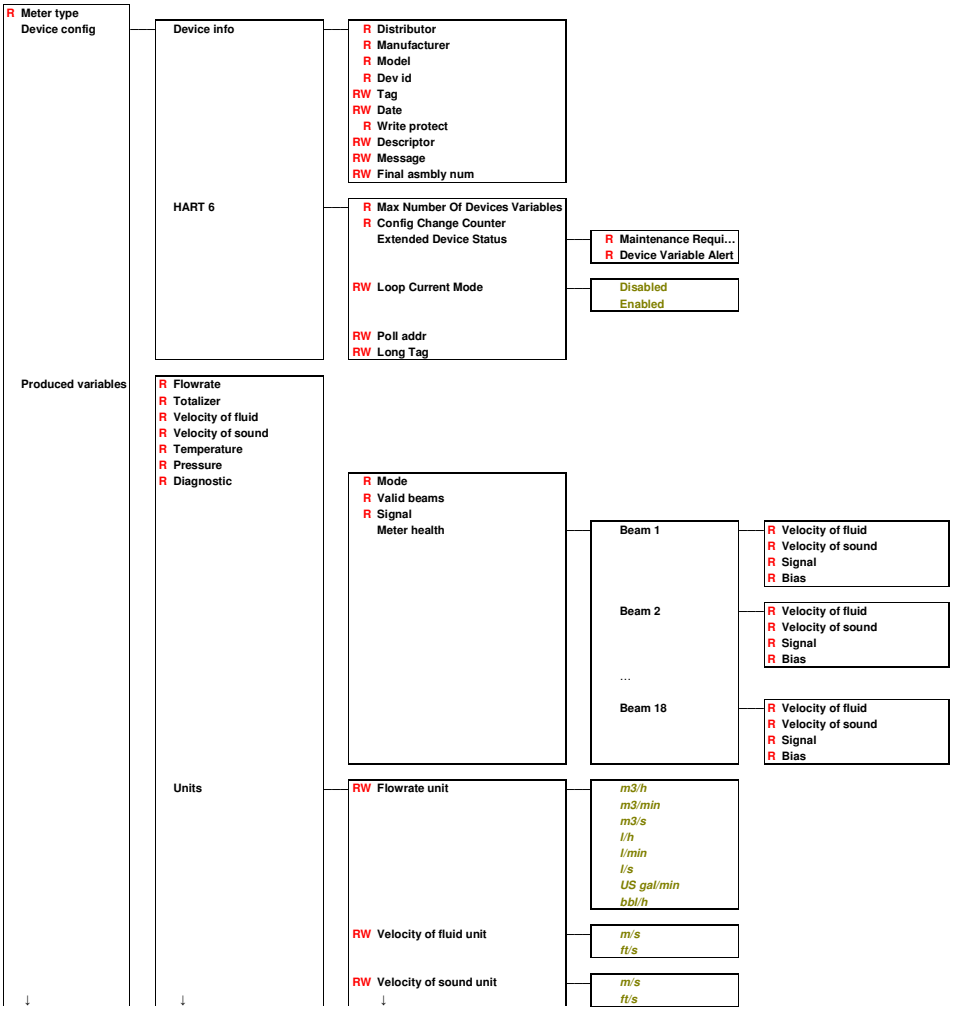
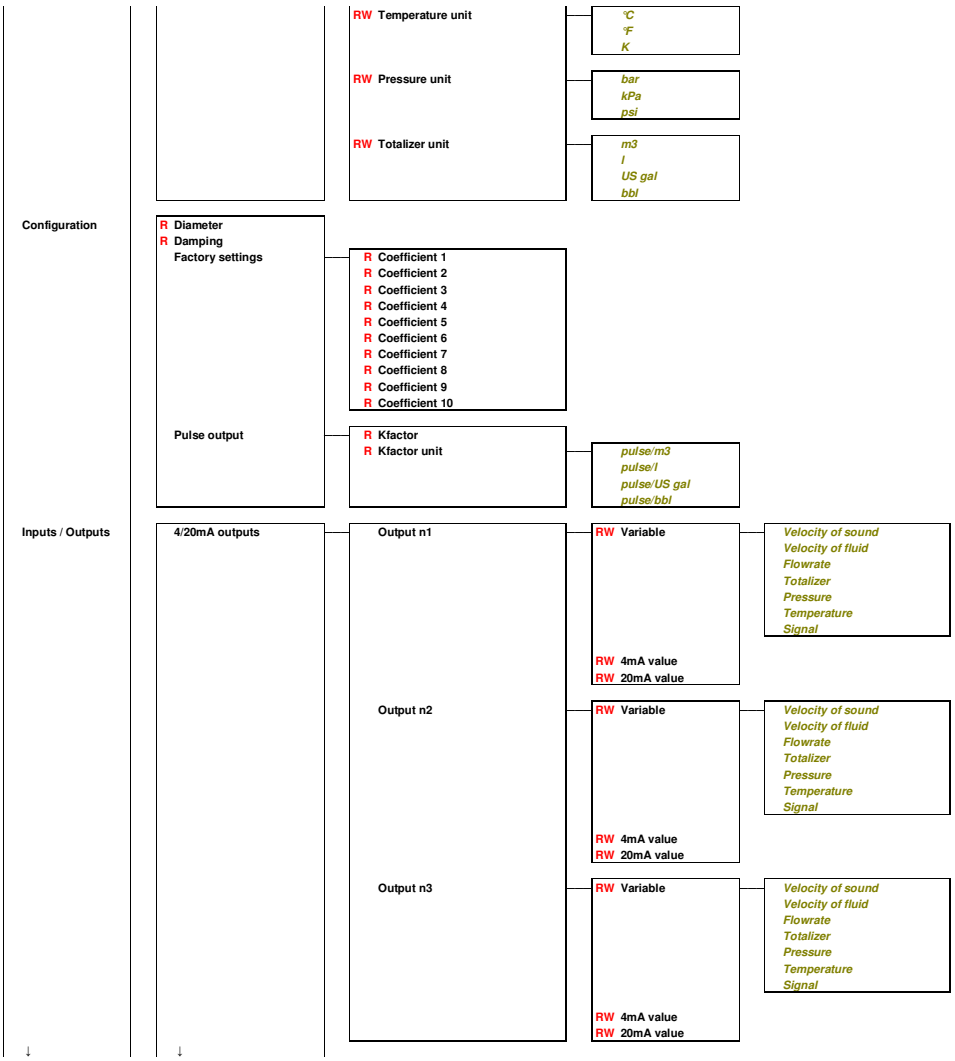
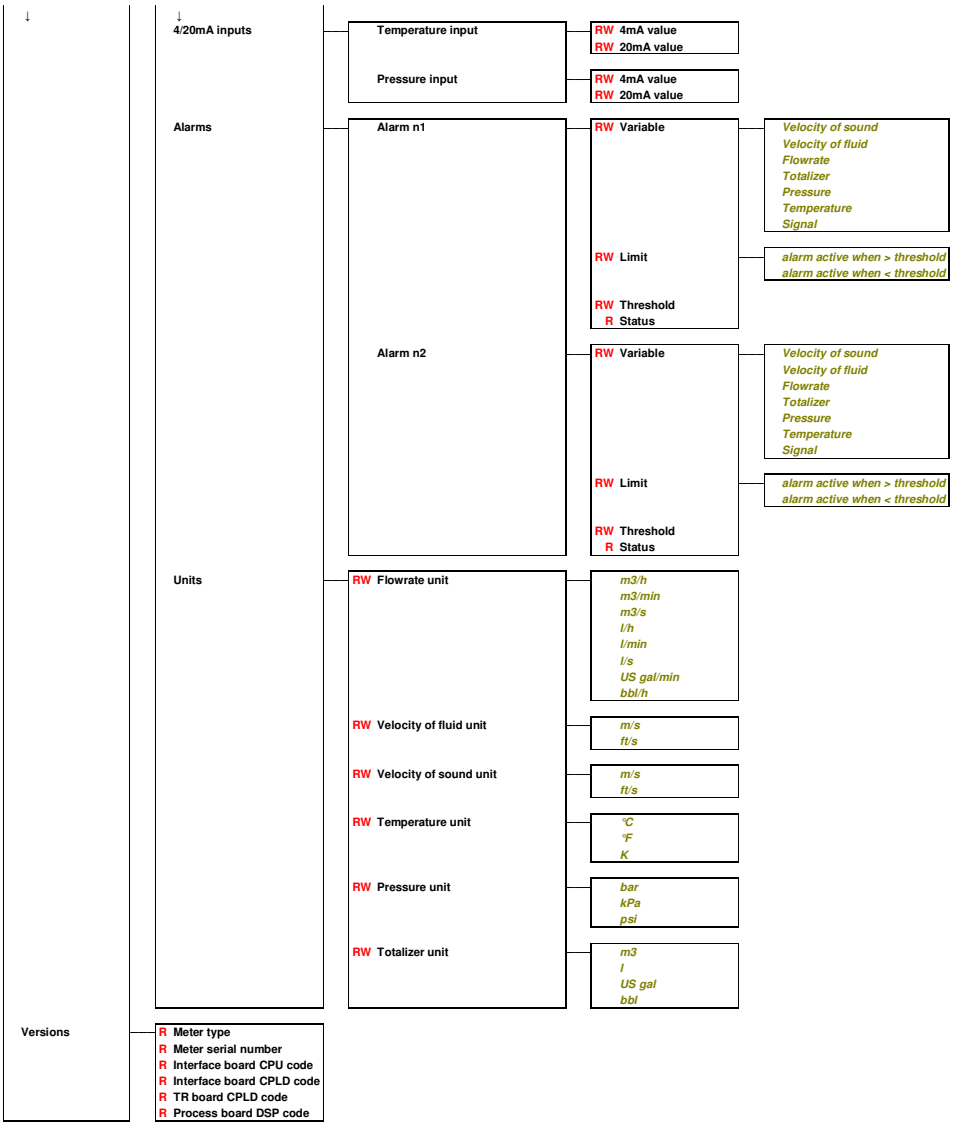
Appendix IV

FH8X00 HART Menu Tree




RW Temperature unit
°C
°F
K
RW Pressure unit
bar
kPa
psi
RW Totalizer unit
m3
l
US gal
bbl
Configuration
R Diameter
R Damping
Factory settings
R Coefficient 1
R Coefficient 2
R Coefficient 3
R Coefficient 4
R Coefficient 5
R Coefficient 6
R Coefficient 7
R Coefficient 8
R Coefficient 9
R Coefficient 10
Pulse output
R Kfactor
R Kfactor unit
pulse/m3
pulse/l
pulse/US gal
pulse/bbl
Inputs / Outputs
4/20mA outputs
Output n1
RW Variable
Velocity of sound
Velocity of fluid
Flowrate
Totalizer
Pressure
Temperature
Signal
RW 4mA value
RW 20mA value
Output n2
RW Variable
Velocity of sound
Velocity of fluid
Flowrate
Totalizer
Pressure
Temperature
Signal
RW 4mA value
RW 20mA value
Output n3
RW Variable
Velocity of sound
Velocity of fluid
Flowrate
Totalizer
Pressure
Temperature
Signal
RW 4mA value
RW 20mA value

Appendix IV


↓
↓
4/20mA inputs
Temperature input
RW 4mA value
RW 20mA value
Pressure input
RW 4mA value
RW 20mA value
Alarms
Alarm n1
RW Variable
Velocity of sound
Velocity of fluid
Flowrate
Totalizer
Pressure
Temperature
Signal
RW Limit
alarm active when > threshold
alarm active when < threshold
RW Threshold
R Status
Alarm n2
RW Variable
Velocity of sound
Velocity of fluid
Flowrate
Totalizer
Pressure
Temperature
Signal
RW Limit
alarm active when > threshold
alarm active when < threshold
RW Threshold
R Status
Units
RW Flowrate unit
m3/h
m3/min
m3/s
l/h
l/min
l/s
US gal/min
bbl/h
RW Velocity of fluid unit
m/s
ft/s
RW Velocity of sound unit
m/s
ft/s
RW Temperature unit
°C
°F
K
RW Pressure unit
bar
kPa
psi
RW Totalizer unit
m3
l
US gal
bbl
Versions
R Meter type
R Meter serial number
R Interface board CPU code
R Interface board CPLD code
R TR board CPLD code
R Process board DSP code

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Appendix V

Pipe Flanges and flanged fitting ASME B16.5-2003

Table 2-1.1 Pressure – Temperature ratings for Group 1.1 Materials

Nominal Designation	Forgings	Castings	Plates
C–Si	A 105 (1)	A 216 Gr. WCB (1)	A 515 Gr. 70 (1)
C–Mn–Si	A 350 Gr. LF2 (1)		A 516 Gr. 70 (1), (2)
C–Mn–Si–V	A 250 Gr. LF6 Cl. (4)		
3½ Ni	A 350 Gr. LF3		A 537 Cl. 1 (3)

	Working Pressure by Classes, bar						
Class Temp., °C	150	300	400	600	900	1500	2500
−29 to 38	19.6	51.1	68.1	102.1	153.2	255.3	425.5
50	19.2	50.1	66.8	100.2	150.4	250.6	417.7
100	17.7	46.6	62.1	93.2	139.8	233.0	388.3
150	15.8	45.1	60.1	90.2	135.2	225.4	375.6
200	13.8	43.8	58.4	87.6	131.4	219.0	365.0
250	12.1	41.9	55.9	83.9	125.8	209.7	349.5
300	10.2	39.8	53.1	79.6	119.5	199.1	331.8
325	9.3	38.7	51.6	77.4	116.1	193.6	322.6
350	8.4	37.6	50.1	75.1	112.7	187.8	313.0
375	7.4	36.4	48.5	72.7	109.1	181.8	303.1
400	6.5	34.7	46.3	69.4	104.2	173.6	289.3
425	5.5	28.8	38.4	57.5	86.3	143.8	239.7
450	4.6	23.0	30.7	46.0	69.0	115.0	191.7
475	3.7	17.4	23.2	34.9	52.3	87.2	145.3
500	2.8	11.8	15.7	23.5	35.3	58.8	97.9
538	1.4	5.9	7.9	11.8	17.7	29.5	49.2

NOTES:

(1) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible but not recommended for prolonged use above 425°C.

(2) Not to be used over 455°C.

(3) Not to be used over 370°C.

(4) Not to be used over 260°C.

Appendix V

Pipe Flanges and flanged fitting ASME B16.5-2003

Table 2-1.2 Pressure – Temperature ratings for Group 1.2 Materials

Nominal Designation	Forgings	Castings	Plates
C-Mn-Si		A 216 Gr. WCC (1) A 352 Gr. LCC (2)	
C-Mn-Si-V	A 350 Gr. LF6 Cl. (3)		
2½Ni		A 352 Gr. LC2	A 302 Gr. B (1)
3½Ni		A 352 Gr. LC3	A 203 Gr. E (1)

	Working Pressure by Classes, bar						
Class Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	19.8	51.7	68.9	103.4	155.1	258.6	430.9
50	19.5	51.7	68.9	103.4	155.1	258.6	430.9
100	17.7	51.5	68.7	103.0	154.6	257.6	429.4
150	15.8	50.2	66.8	100.3	150.5	250.8	418.1
200	13.8	48.6	64.8	97.2	145.8	243.2	405.4
250	12.1	46.3	61.7	92.7	139.0	231.8	386.2
300	10.2	42.9	57.0	85.7	128.6	214.4	357.1
325	9.3	41.4	55.0	82.6	124.0	206.6	344.3
350	8.4	40.0	53.4	80.0	120.1	200.1	333.5
375	7.4	37.8	50.4	75.7	113.5	189.2	315.3
400	6.5	34.7	46.3	69.4	104.2	173.6	289.3
425	5.5	28.8	38.4	57.5	86.3	143.8	239.7
450	4.6	23.0	30.7	46.0	69.0	115.0	191.7
475	3.7	17.1	22.8	34.2	51.3	85.4	142.4
500	2.8	11.6	15.4	23.2	34.7	57.9	96.5
538	1.4	5.9	7.9	11.8	17.7	29.5	49.2

NOTES:
(1) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 425°C.
(2) Not to be used over 340°C.
(3) Not to be used over 260°C.

Appendix V

Pipe Flanges and flanged fitting ASME B16.5-2003

Table 2-2.2 Pressure – Temperature ratings for Group 2.2 Materials

Nominal Designation	Forgings	Castings	Plates
16Cr-12Ni-2Mo	A 182 Gr. F316 (1) A 182 Gr. F316H	A 351 Gr. CF3M (2) A 351 Gr. CF8M (1)	A 240 Gr. 316 (1) A 240 Gr. 316H
18Cr-13Ni-3Mo	A182Gr. F317 (1)		A 240 Gr. 317 (1)
19Cr-10Ni-3Mo		A 351 Gr. CG8M (3)	

Class	Working Pressures by Classes, bar						
Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	19.0	49.6	66.2	99.3	148.9	248.2	413.7
50	18.4	48.1	64.2	96.2	144.3	240.6	400.9
100	16.2	42.2	56.3	84.4	126.6	211.0	351.6
150	14.8	38.5	51.3	77.0	115.5	192.5	320.8
200	13.7	35.7	47.6	71.3	107.0	178.3	297.2
250	12.1	33.4	44.5	66.8	100.1	166.9	278.1
300	10.2	31.6	42.2	63.2	94.9	158.1	263.5
325	9.3	30.9	41.2	61.8	92.7	154.4	257.4
350	8.4	30.3	40.4	60.7	91.0	151.6	252.7
375	7.4	29.9	39.8	59.8	89.6	149.4	249.0
400	6.5	29.4	39.3	58.9	88.3	147.2	245.3
425	5.5	29.1	38.9	58.3	87.4	145.7	242.9
450	4.6	28.8	38.5	57.7	86.5	144.2	240.4
475	3.7	28.7	38.2	57.3	86.0	143.4	238.9
500	2.8	28.2	37.6	56.5	84.7	140.9	235.0
538	1.4	25.2	33.4	50.0	75.2	125.5	208.9
550	...	25.0	33.3	49.8	74.8	124.9	208.0
575	...	24.0	31.9	47.9	71.8	119.7	199.5
600	...	19.9	26.5	39.8	59.7	99.5	165.9
625	...	15.8	21.1	31.6	47.4	79.1	131.8
650	...	12.7	16.9	25.3	38.0	63.3	105.5
675	...	10.3	13.8	20.6	31.0	51.6	86.0
700	...	8.4	11.2	16.8	25.1	41.9	69.8
725	...	7.0	9.3	14.0	21.0	34.9	58.2
750	...	5.9	7.8	11.7	17.6	29.3	48.9
775	...	4.6	6.2	9.0	13.7	22.8	38.0
800	...	3.5	4.8	7.0	10.5	17.4	29.2
816	...	2.8	3.8	5.9	8.6	14.1	23.8

NOTES:
(1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.
(2) Not to be used over 455°C.
(3) Not to be used over 538°C.

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Appendix VI

Operating restrictions – Special recommendations

The equipment nominal operating field is specified on its nameplate. This field is mainly defined in terms of:

- Minimum/Maximum – Flowrate
- Maximum – Pressure
- Minimum/Maximum – Temperature

The flowrate restrictions specify the equipment optimal performance field (measurement accuracy and repeatability).

The pressure and temperature restrictions involve exclusively the equipment mechanical dimensions and define the authorized operating field.

> *Remark: When the operating temperature is higher than the indicated value the maximum authorized pressure shall be reduced, in strict application of the NF EN 1759-1 Standard.*

Gasket

The equipment shall be assembled with gaskets according to NF EN 1514 and NF EN 12560 standards and depending on flange type.

Spiral wound gaskets are forbidden for flanges rating below class 300 or PN 63.

Flange bolting

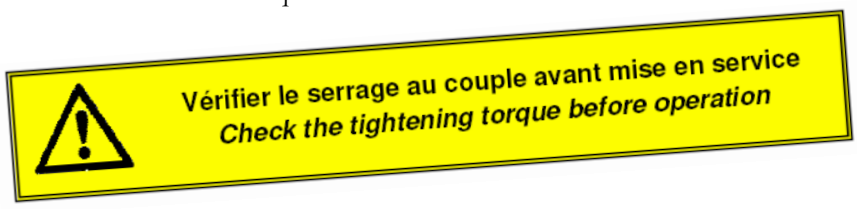
The material of flange bolting shall be chosen in ASTM A 193 B7 (rods) and ASTM A 194 2H (nuts) according to EN ISO 898-1 standard for temperature between -45°C and +480°C.

Tightening torque

Recommended tightening torque for Klingersil gasket type

Bolt size	Nm	Bolt size	Nm
M14	110	M30	1130
M16	170	M33	1520
M20	330	M36	1960
M24	570	M39	2525
M27	828	M42	3135

The link of a flowmeter equipped with a flow straightener is tightened at the factory but must be checked and retightened before commissioning. A label affixed to the flanges of this link calls attention to this requirement.



Appendix VI

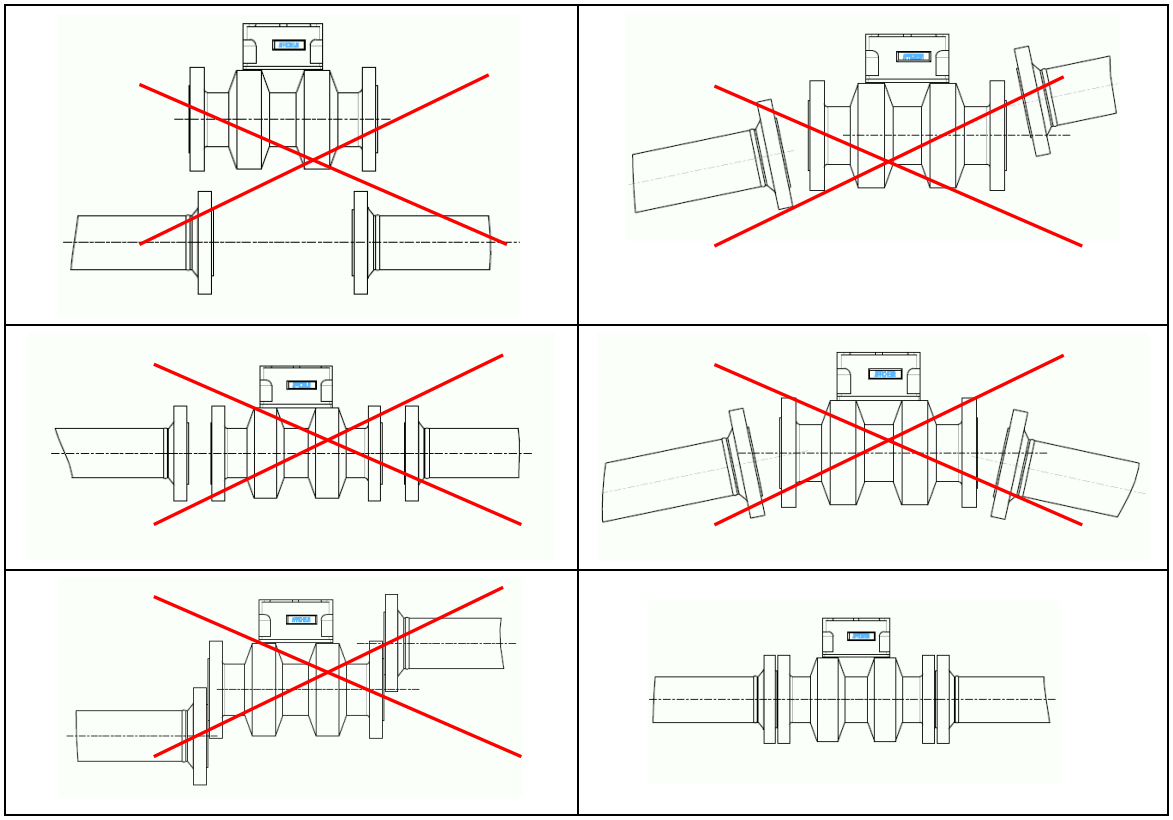
Equipment installation

Before installation, keeping the equipment in its original packing, sheltered from bad weather and possible impacts.

The equipment mechanical installation on the measurement line shall not generate excessive stresses. Especially, the alignment of upstream and downstream flanges shall allow to avoid the transmission of stresses on the equipment body.

The equipment shall be installed by means of the suitable tools.

- Never use a hammer or impact wrench.
- No equipment element is designed to contribute to the tightening of connecting rods.
- Specific tools shall be used, when necessary, for the spacing between upstream and downstream flanges.



Lifting or pre-positioning means used, when necessary, shall be kept in place until installation achievement (tightening of all connecting rods).

Check the fitting of new gaskets, adapted to the application (material) and flange size.

Equipment disassembly

By definition, the equipment is designed to operate under pressure. Allowing for the potential danger these fluids represent, the equipment shall be imperatively and completely drained, before disassembling the equipment (complete disassembly or removal of a component under pressure).

Should this draining need partial de-tightening of the equipment connecting rods, check the line is perfectly de-pressurized before de-tightening and implementation of the liquid recovery tank.

Flange gaskets shall not be re-used.

Important

The equipment is a measuring instrument and shall be used as such.

The equipment body of the associated components (flowstraightener, bosses …) are designed to support stresses in reasonably foreseeable operating conditions. They are not designed to be used as supports, equipment carry means or step.

Any modification brought to the equipment, susceptible to affect the pressure resistance, after delivery, is STRICTLY PROHIBITED.

For any replacement of Electronic Board, the used Electronic Board is subjected to restrictive disposal according to the WEEE Directive.

The disposal of the used Electronic Board should be either sent back to Faure Herman who will take care of its disposal, or dispose by the customer according to the EPA rules of its country.

Detailed contents

General contents 5

ATEX recommendations 7

Protection hazardous area 10

ATEX recommendations for FH8500 transducer 11

ATEX recommendations for FH8500 electronic enclosure 13

Chapter 1: General overview 15

Measuring principle 15

Sizes and Flowrates 18

Standard K-factors 18

Working modes 18

Constitutive parts of the FH8500 19

FH8500 inputs-outputs 20

Data logger and Event logger 21

Maximum line pressure 22

Pressure drop 22

Using the FH8500 in a vertical pipe 22

Power supply 22

Other characteristics 23

Chapter 2: Commissioning procedure 25

FH8500 handling 25
Reception and storage 25
Choice of the FH8500 location on the pipe 26
Installing the FH8500 26
Cabling the FH8500 27
Setting the FH8500's parameters 33
Commissioning of the plant 33

Chapter 3: Using the FH8500 remote control device 35

Remote control device's keypad 36
Information displayed in measure mode 36
General parameter setting procedure 37
Principle of menus and sub-menus numbering 37
Menus and sub-menus structure 38
Selection of units 39
Setting the analog outputs 41
Setting the temperature input 42
Setting the pressure input 42
Setting the alarms 42
Setting the serial link 43
Setting the data logger and resetting both loggers 44
Setting FH8500 date and time 44
Setting the back-light 45

Resetting the totalizer 45
Display of the temperature corrected inside diameter 45
Display of the serial number 45
Time constant of the floating average filter 45
Factory set parameters 46
Setting the K-factor 46
Zeroing 46

Chapter 4: Spare parts and Maintenance 47

Spare parts 47

1. Replacing the converter's electronics 48
Removing the electronics 48
Installing a new converter's electronics 50

2. Removing and replacing the transducers 51
Removing a transducer 51
Installing a new transducer 55

3. Performing a zeroing procedure 56

Chapter 5: Modbus transmission tables 57

Avalaible tables 57
Main characteristics of the transmission 59
Transmission formats 59
Framework for the reading of "n" Modbus words (1 ≤ n ≤ 125) 60
Framework for the writing of n Modbus words (1≤ n ≤ 123) 61

Structure of the table n°1 62
Structure of the table n° 2 66
Structure of the table n° 3 69
Structure of the table n° 4 72
Structure of the table n° 5 74
Structure of the table n° 6 79
Structure of the table n° 7 80
Structure of a Data logger record 81
Structure of the table n° 8 84
Structure of an Event logger record 85

Appendix I 87
Dimensions, weight, maximal flow rate vs meter size 87

Appendix II 89
Lifting Arrangement Drawing 89
Lifting Arrangement Drawing 90

Appendix III 91
FH8X00 HART Commands list 91

Appendix IV 93
FH8X00 HART Menu Tree 93

Appendix V 97

Pipe Flanges and flanged fitting ASME B16.5-2003 97
Table 2-1.1 Pressure – Temperature ratings for Group 1.1 Materials 97
Pipe Flanges and flanged fitting ASME B16.5-2003 98
Table 2-1.2 Pressure – Temperature ratings for Group 1.2 Materials 98
Pipe Flanges and flanged fitting ASME B16.5-2003 99
Table 2-2.2 Pressure – Temperature ratings for Group 2.2 Materials 99

Appendix VI 101

Operating restrictions – Special recommendations 101
Gasket 102
Flange bolting 102
Tightening torque 102
Recommended tightening torque for Klingersil gasket type 102
Equipment installation 103
Equipment disassembly 105

Detailed contents 107

Personal notes 113

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